SOUTH AUSTRALIAN SHELLS.

(Including descriptions of New Genera and Species).

PART V.

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In this part the following families are treated:—

Muricidae, Thaididae, Ellobiidae, Amphibolidae, Siphonariidae, Limnaeidae, Planorbidae, Ancylidae, Pupillidae, Succineidae, Helicidae and Rhytididae.

MURICIDAE.

Spindle-shaped, spire moderately long; axial ribs, spinous or leaf-like; canal elongate, sometimes closed by the approachment of the opposite margins. Operculum ovate, horny, nucleus almost or quite terminal. Distribution—World-wide, tropical or temperate, ranging from low water to moderate depths. Fossil—Cretaceous.

Animal with a moderately long foot, truncated in front; tentacles elongate, bearing eyes high up on the sides. Carnivorous, feeding on Gastropods and Pelecypods, whose shell they pierce with the radula, forming a round hole, through which they insert their long proboscis. Sexes separate. In Europe, *Murex* (*Ocinebra*) *erinaceus* Linne is considered one of the most dangerous enemies the oyster-farmer has to deal with, and much time is given to its destruction. The depredator settles upon the shell of the oyster near the umbo, and for three or four hours the radula rasps a hole. The bored oyster soon dies or else, exhausted, the adductor muscle ceases to function and the valves open, thereby admitting other animal robbers who are quick to profit by the labour of the Murex. The purple of the ancients was obtained from *Murex* (*Rhinocantha*) *brandaris* Linne and *M. trunculus* Linne. The small shells were bruised in mortars, the animals of the larger ones taken out. On the Tyrian shore are heaps of broken shells and the caldron-shaped holes in the rocks where they are triturated. The pigment, contained in cells of the mantle, is colourless or yellowish, but under the influence of light turns yellow, green, blue and then purple. The dye can be fixed upon fibres without the help of a mordant, and the colour is brilliant and solid. *M. brandaris* and *trunculus* are sold for food in the markets on the coast of the Adriatic. Many species in this family are commonly known as "Rock-shells," from the roughness and irregularity of their surface. They abound

in shallow waters and are often covered by extraneous marine substances. The different periods of their growth, or rather of their enlargement by the animal, are marked off by thickened ribs called varices. The shells, especially from tropical waters, are frequently brilliantly coloured, and the elaborate structure, the ramifications of the spiny, branched, or fringed varices, have established them as favourites with collectors. *Murex tenuispina* Lamarck "The Comb of Venus," also called "The Slender-spined Murex," with its long canal and long rows of slender parallel spines, is found in Northern Australia, but there is no spiny species (typical Murex) at present living in Southern Australia. "The Scorpion Murex," *M.* (*Homalocanthus*) *scorpio* Linne, with the varix in fronds having dilated apices, inhabits the Eastern Archipelago. *M.* (*Muricanthus*) *radix* Gmelin, from Panama, has fine black, short spines. The "Royal Murex," *M.* (*Phyllonotus*) *regius* Wood, from Panama, has a brilliant crimson mouth. The "Branching Murex," *M.* (*Chicoreus*) *ramosus* Linne, from the Barrier Reef, has the inside of the mouth a delicate flesh-pink. The "Stag-horn Murex," *M.* (*Chicoreus*) *cervicornis* Lamarck, from Northern Australia has forked points at its larger fronds. *M.* (*Chicoreus*) *palma-rosae* Lamarck, from Ceylon has tinted tips of finely toothed fronds. *M.* (*Haustellum*) *haustellum* Linne, from China, has a very long canal, and but a few short spines which are placed along the canal. These are nearly all large shells. The largest representative of the family in South Australia is *Pteronotus triformis* Reeve, a "Rock Shell."

Chicoreus Montfort. Triangularly ovate; varices three, foliated and sometimes spinose; canal as long as the mouth, curved, wide, nearly closed. Type—*Murex ramosus* Linne.

C. denudatus Perry 1811 (*Triplex*) (=*Murex australis* Quoy & Gaimard 1833: =*M. palmiferus* Sowerby 1840). Pinkish-brown or white; spire rather elongated, pointed, turreted; spirally ridged and striated, two prominent tubercles between the varices; varices three, somewhat thickened, with a single row of short, rather compressed folds, often fimbriately connected at the side; whorls somewhat ventricose; outer lip denticulated; canal of medium length, recurved. Height 36; diam. 20 mm. Subfossil in South Australia. Largs Bay, two examples from shell debris (Henn). Alive in North Australia. Gatliff recorded this from Victoria as *Murex abortivus* Perry, a different species. *C. denudatus* is recognised by its short compressed fronds, which are usually so close side by side, as to form a connected leaf-like frill. (Type locality—Van Dieman's Land [Perry in error] North Australia).

Pteronotus Swainson 1833 (=*Pteropurpura* Jousseaume 1879: =*Poropteron* Jousseaume 1879. *Poropteron* is regarded by some as a sub-genus). Triangular, varices three, fin-like or leaf-like; spire elevated; whorls rounded; mouth ovate; outer lip generally simple, but sometimes crenulated; canal somewhat curved, nearly closed; operculum horny, ovate, with nucleus scarcely terminal. Type—*Murex pinnatus* Swainson, not of Wood. (China).

P. triformis Reeve 1845 (*Murex*) (=*M. zonatus* Tenison-Woods 1876). Pl 1, fig. 2. "The Common Rock-shell." Angularly elongate, triangular, spire two-fifths of the length of body-whorl; brownish, usually increasing to deep purple; some are creamy white; inside white; closely spirally striated, the grooves ending in a frill on the three varices; whorls six, angulated towards the upper part and with two or more nodules between the varices; varices with a single open projection or spine posteriorly, both on the spire and body whorls, in a line with the nodosites; on perfect specimens there is a curved spine of varying length medially to and on the left of the canal; mouth ovate, but sinuating considerably above, near the outer lip, which is finely crenate; inner lip smooth, spreading over the columella; canal somewhat long, not quite closed, and usually increasingly open towards the lower end which is strongly recurved. Height 97, diam. 56 mm. Generally distributed throughout South Australia, beach, and dredged to 100 fathoms, alive to 22 fathoms, rather common. Also Western Australia, west to Bunbury, down to 15 fathoms; Victoria; Tasmania, where the specimens are much smaller. (Type locality—New Holland). An attractive shell when in good condition. The varices form a frill nearly the whole length of the shell, which is especially conspicuous on the margin of the outer lip, and, in good specimens, the recurved canal becomes hook-like. This species is better placed here than under *Pterochelus* Jousseaume, which we regard as a synonym.

P. angasi Crosse 1863 (*Typhis*) (= *Murex cordismei* Watson 1886). Pl. 1., fig. 1. "Angas' Pteronotus." Trigonal, elongate, rather thin, nearly translucent; light yellow, with a violet band, also violet at the suture, (an exceptional specimen is blackish-purple, with a central white band over the body-whorl and over the lower half of the outer lip and the columella and inner border of the canal, so that the upper third of the varix is purple, and the lower two-thirds white); whorls about six; varices three, leaf-like slightly discontinuous, rising at the shoulder into semitubular, upturned, and slightly reverted spines; two minute, rounded tubercles between the spines; also a tube-like spine curved downwards and outwards, to the left of the

middle of the beak, frequently wanting in beach specimens; mouth roundly oval, small, white within, with two violet bands; outer lip widely foliated; columella curved, white; canal slightly oblique, recurved. Height 23, diam. 11.5 mm. General, beach to 110 fathoms, alive down to 12 fathoms. Uncommon. Also Esperance beach, W.A. (Type locality—Port Jackson). Peronian specimens are less stout, and the spurs are white, with a light purple-brown band at the middle of the body whorl, spreading at the outer lip. *P. angasi* has the general appearance of young *P. triformis*, but the varices at their juncture with the suture are very canaliculate and much hooked backwards. The New Zealand *Pteronotus cos* Hutton 1873, once considered identical, is now regarded as a different species.

P. robustus Verco 1895 (*Murex* [*Poropteron*]). "The Robust Pteronotus." Ovate, trigonal, solid, spire a little shorter than the body-whorl; yellowish-white (very young specimens have two chestnut spiral lines); prontoconch of one-and-a-half turns, slightly papillate; adult whorls six, scarcely convex, nearly smooth on the spire whorls; body-whorl rather rugged, with five or six faint spiral lirae, and very fine growth lines; varices three, low and stout, ending close to the suture in a tube, trigonal in section, stout and sinuous, like a horn, extending backwards, hollow, rugged; sutures distinct; mouth oval, slightly oblique, small, entire; peristome projecting as a thin, detached, simple, sharp lamina; six rounded, tubular, spiral ribs, extending on the outside of the outer lip to the margin of the varix (the counterpart of the short, stout, spiral buttresses on the left side of the varices on the spire); columella invisible; canal completely closed, just longer than the mouth, at its lower end bent at a right angle and then curved slightly to the right, with a capillary opening from a little behind the bend to the extremity, the labial varix saw-like, with nine claw-like processes; operculum horny, ovate, nucleus terminal below. Height 14.25, diam. 7 mm. Rare. (Type locality—Backstairs Passage, 22 fathoms); Gulf St. Vincent, depth uncertain. Superficially it resembles *P. angasi* which is a narrower, thinner shell, with a single curved (not sinuous) and open posterior variceal hook, an open anterior canal, and a simple mouth.

P. tatei Verco 1895 (*Murex*). "Tate's Pteronotus." Squarely pear-shaped, light, porous; greyish-white; partly reddish-brown inside, indistinctly visible without; spiral lirae, six on the penultimate whorl, crossed by regular, thin, close-set, axial laminae producing a coral-like effect; varices five, not quite regularly disposed, well-marked, rather wider than high, rounded and slightly reflected, most prominent above the shoulder; spire less

than one-third the length of the shell; protoconch conspicuous, papillate, of one-and-a-half turns, smooth, purplish-black, suture somewhat channelled; adult whorls four, convex, roundly shouldered above; mouth obliquely oval; outer lip simple, finely crenulated, and lirate within, thickened outside; inner lip distinct on the curved columella; canal slightly longer than the mouth, deflected first to the left, then straight, then to the left, almost closed, and sharply recurved at the anterior extremity; operculum horny, nucleus terminal below. Height 15, diam. 9.5 mm. Rare. (Type locality—Backstairs Passage, 17-22 fathoms).

Murexsul Iredale 1914. Ovate, sometimes narrowly umbilicated, axially ribbed, tending to develop varices carrying hollow spines on the body-whorl; spiral ribs numerous, narrow, rounded; spire conical, gradate, rather higher than the mouth; protoconch small, of barely two whorls, smooth, flat vertically, topped by a fairly sharp keel, the summit a marked pit, the tip being rather immersed; mouth ovate; outer lip angled above; canal moderate, oblique, recurved, narrowly open; umbilicus narrow, distinct; operculum horny, with nucleus scarcely terminal. Type—*Murex octogonus* Quoy & Gaimard 1833 (New Zealand).

M. umbilicatus Tenison-Woods 1875 (*Trophon*). Pl. 1, fig. 3. "The Umbilicated Murexsul." Ovate, solid, spire raised; yellow or pale chestnut; conspicuously axially ribbed, eight in last whorl, the axial ribs cut across by numerous thick spiral lirae, having a rugged, scaly effect; outer lip crenulate outside and toothed within; inner lip expanded; umbilicus margined with rounded, imbricated scales. Height 28, diam. 20 mm. Guichen Bay to Gulf St. Vincent, Spencer Gulf, St. Francis Island. Beach and dredged to 20 fathoms. Rather uncommon. Also dredged off Esperance, W.A. (Type locality—E. coast of Tasmania). *M. umbilicatus* is distinct from *M. octogonus*, a New Zealand shell, with which it has been confused.

M. brazieri Angas 1877 (*Murex*) (= *Trophon tumidus* Petterd 1884). "Brazier's Murexsul." Ovate, solid, not umbilicated; light-brown, tinged with brownish-purple on the columella and within the mouth; varices six, irregular; spiral ribs strong, erect, five on the last whorl, some of the ribs are double, crossed axially with squamate ridges throughout, which are nodulous on the ribs, and become more foliaceous towards the base; whorls five, somewhat excavated and flattened above; outer lip dentate within; canal, half the length of mouth, slightly recurved. Height 11, diam. 6 mm. All round the South Australian Coast, beach and dredged to 150 fathoms. Not common. Also Western Australia where they are apparently as numerous on the West Coast as on the South. Albany to Fremantle, beach to 22 fathoms. (Type locality—Port Jackson Heads 20 fathoms).

M. fimbriatus Lamarck 1822 (*Murex*) (= *M. planiliratus* Reeve 1845: = *M. polypleurus* Brazier 1894: not *M. pumilus* A. Adams 1853 from the China Seas). "The Fimbriated Murex-sul." Small, spindle-shaped, not umbilicated; somewhat grey, or flesh coloured; varices eight, continuous, crossed by fine spiral lirae, the interstices very finely striate, or scabrous; whorls about five, bluntly angulated; suture slightly impressed, smooth; mouth oval, attenuated below; outer lip thickened by the external varix, with five to six small nodose teeth within; inner lip with one small rounded tooth near the canal. Height 15, diam. 10 mm. Generally distributed, South Australia, beach and dredged to 110 fathoms. Not common. Also Western Australia, west to Rottnest Island, beach and down to 28 fathoms. (Type locality —King George Sound). Formerly confused with *M. pumilus* A. Adams, which is narrower and much shorter, having the canal slightly turned up and crossed by scabrous spiral ridges. We doubt whether this shell differs specifically from *M brazieri.*

The single living specimen said to be the Mediterranean *Murex serotinus* A. Adams taken alive at Aldinga Bay is probably *M. fimbriatus.*

Galfridus Iredale 1924. Ovately spindle-shaped, with rounded whorls, and false umbilicus; lamelliform axials and fine crowded spirals; protoconch of two turns, closely spirally lirate; suture impressed; mouth rather large; outer lip thin, with a notch close to the suture; canal short, open; operculum horny. Type—*Triton speciosus* Angas 1871. (N.S.W.).

G. eburneus Petterd 1884 (*Trophon*) (= *Daphnella eburnea* Petterd (Verco): = *Tritonidea eburnea* Petterd (Adcock): not *G. speciosus* Angas 1871 [*Triton*] from N.S.W.). "The Ivory-white Galfridus." White, dull; growth lines irregular, lamellar, making a frill immediately below the suture, corresponding with a small round sinus there; spirals fine, crowded; spire less than half the height of the mouth; protoconch two-whorled, with twelve spirals; adults whorls about three, rounded; the false umbilicus, which is absent from young shells, is only a separation of the lower part of the inner lip from the sinistral twist of the extremity of the columella. Height 14, diam. 7 mm. Beach, Port Willunga, Fowler Bay, Venus Bay, St. Francis Island, and dredged Backstairs Passage, 17 fathoms. Rather rare. (Type locality—Tamar Heads, Tasmania). Occurs also in Tasmania and Victoria. *G. eburneus* is smoother and thinner than *speciosus,* and the thick varices of the latter are reduced in *eburneus* to mere lines of growth. *G. eburneus* is the Flindersian shell.

Typhis Montfort 1810 (from typhos, smoke) (= *Typhina* Jousseame 1879). Small, oval-oblong, varices spinose, usually four, and projecting hollow tubes between them; tubes formed by a fold, the edges of which are appressed so closely that the shelly secretion forms a perfect cylinder; in some species the varix commences with, and at the tube, though mostly developed beyond it; spire elevated; mouth rounded; peristome continuous; columella smooth; canal short, tubular; operculum oval, nucleus terminal. Type *Murex tubifer* Bruguiere, an Eocene fossil. (The type of *Typhina* is *Typhis belcheri* Broderip, from N.S.W.) The last tubular spine is lined by a prolongation of the mantle-margin of the animal, and is the regular outlet for effete matter, as the earlier formed tubes have been successively. The same remark applies to the last perforation in the shell of *Haliotis* (Mutton Fish). The tubes are of greatest length when first formed, later they seem either to be partly dissolved or broken off. The last tube, until it is broken, is therefore always longer than the others. Specimens from deep water occasionally preserve the tubes, or part of them, in a way to make this evident.

T. yatesi Crosse 1865. Pl. 1, fig. 6. "Yates' Typhis." Rather thin, scarcely translucent; white, slightly tinged with pink; whorls six, each whorl with four varices, wavy, compressed, jagged, ending in a hollow spine, pointed and recurved when it is intact; the space between the varices presents a projecting tube, with a rounded aperture; last whorl narrowed at the base, longer than the spire; mouth small, roundly-oval, entire, white, peristome projecting, detached, simple, sharp; canal completely closed throughout, rather wide, slightly oblique and recurved. The largest specimen, from Gulf St. Vincent, height 24, diam. 13 mm.; specimen illustrated measures, height 18, diam 9.5 mm. Beach, Grange, Semaphore, Outer Harbour, Stansbury. Dredged, Beachport to Port Lincoln, 9-40 fathoms. Also Western Australia—Bunbury, 22 fathoms, one alive, rather short in the spire. Somewhat rare. (Type locality—Gulf St. Vincent). Distinguished by the elegant denticulation of the varices.

Cyphonochelus Jousseaume 1879. Small, ovate, whorls shelved at the shoulder; many double varices, each composed of two evenly spaced elevated folds which fuse at the base, and, uniting in an arch above, project as a short, somewhat bent pipe, at the shoulder; protoconch of one-and-a-half turns, elevated, smooth; canal short, hardly curved, narrowly open. Type—*Typhis arcuatus* Hinds (South Africa).

C. syringianus Hedley 1903 (*Typhis*) (not *Typhis arcuatus* Hinds 1843, from South Africa). Pl. 1, fig. 5. "The Piped Cyphonochelus." Rather solid; pale brown; altogether 20 double varices, united at the outer edge in a curve and terminating in

a short, backwardly bent pipe, at the shoulder; in the hollow between each double varix occurs the scar of the former mouth; growth lines, fine, extend over the whole surface; whorls five; mouth oval, peristome continuous, produced within the varix; canal short, hardly curved Height 9, diam. 5.5 mm. Dredged Cape Jaffa 130 fathoms, Beachport 200 fathoms, 35 miles S.W. of Neptune Islands 104 fathoms. (Type locality—Cape Three Points, N.S.W., 41-50 fathoms). Varies somewhat in the length of spire so that some are much more elate than others, also in the prominence of the axial costae going to and between the tubes. It has been mistaken for *Typhis arcuatus* Hinds 1843, a South African shell, which is considerably larger, has fewer and less upright folds, a longer and more curved canal, brighter colour and more prominent protoconch. *C. syringianus* differs from *Typhis yatesi* in being smaller, and in its double varices, which contain fewer and differently shaped denticulations.

C. bivaricatus Verco 1909 (*Typhis*). White, tinged with brown below the suture and the periphery; each spire whorl bears four projecting tubes with a rounded aperture; between these are double varices, the more prominent leaf midway between the tubes, the other just behind a tube; each leaf is flexuous and tridentate, and ends behind in a hollow-pointed recurved spine, from the narrowed base of the body-whorl projects the ends of three canals, towards each of which the two leaves of a varix converge to unite; mouth roundly oval, small, entire, peristome projecting, detached, simple, sharp; canal completely closed, wide, oblique, recurved; tube long, round, curved. Height 5.5, diam. 2.6 mm. (Type locality—35 miles S.W. of Neptune Islands, 104 fathoms, 20 examples dead). Probably the juvenile of *C. syringianus*.

Litozamia Iredale 1929. Small, spindle-shaped, turreted; axial ribs, rounded, crossed by spiral lirae; spire well raised; protoconch of about two-and-a-half whorls, smoothly granular, flat-topped and flat-sided, united at a right angle; adult whorls convex; mouth ovate, oblique; outer lip usually rather thick, slightly varixed behind; canal short, curved. Type—*Peristernia rudolphi* Brazier 1894 (from Green Point, Watson's Bay, Sydney, N.S.W.). Distinguished by the short fusiform shape, moderate canal and smooth protoconch.

L. rudolphi Brazier 1894 (*Peristernia*). Pl. 1, fig. 8. "Rudolph's Litozamia." Yellowish-brown, with large dark reddish-brown spots below the suture and nearly on the angle of the whorls; axial ribs, rather wider than the interspaces, rounded, crossed by numerous spiral lirae, very conspicuous on the edge of the ribs, finer between and at the sides; three to four small nodules within the outer lip. Height 6.5, diam. 4 mm. Off

Beachport, 40-110 fathoms, Cape Borda 55 fathoms, rare. Also Western Australia, beach, Hopetown, Albany, Ellensbrook, Yallingup, Rottnest Island. (Type locality—Green Point, Watson's Bay, Sydney, N.S.W.).

L. goldsteini Tenison-Woods 1875 (*Trophon*). "Goldstein's Litozamia." Short; chalky-white; distant, scarcely raised spiral lirae (four in last whorl) do not pass over the axial ribs which are scaly and flexuous anteriorly; adult whorls six, convex, angulate and coronate above; mouth ovate, enamelled, and chestnut-brown banded within; columella twisted; canal twisted, flexuous. Height 16, diam. 8 m.m. General in South Australia but not common—beach to 150 fathoms. (Type locality—Long Bay, Tasmania). Some shells, dredged Gulf St. Vincent, are smaller, and with less prominent spiral lirae. The shell of *L. goldsteini* is composed of two distinct layers, an inner enamel-like foundation and an outer dull white, loose textured, soft chalk-like coating. In beach-rolled specimens this is more or less removed, leaving only the hard shining enamel-like basis, which shows numerous spiral threadlets besides the few scarcely raised spiral lirae. After comparison with shells in the British Museum this species appears closely allied to *Murex distinctus* Cristofer, from the Mediterranean; another shell *M. scalaroides* Blainville from Naples in the British Museum is almost certainly identical with *distinctus*.

L. brazieri Tenison-Woods 1875 (*Trophon*). "Brazier's Litozamia." Ovately spindle-shaped, attenuate at both ends; dull white; varices, six on the last whorl, strong, rib-like, convex in the middle; smooth or finely striate; spire scarcely turreted, almost acute; adult whorls about five; mouth ovate, enamelled chestnut; outer lip thin, indistinctly brown-banded within; columella somewhat tuberculate below; canal subelongate, recurved. Height 10, diam. 5mm. Macdonnell Bay, not common. More common Victoria and Tasmania. (Type locality—Long Bay, Tasmania). The enamelled chestnut mouth and narrow form easily distinguish it.

L. angusta Verco 1895 (*Trophon*). "The Narrow Litozamia." Spindle-shaped; dull white; varices, six, slightly higher than wide, sinuous; spiral lirae, slightly raised, broad, about five on last whorl, with two to five intervariceal axial lirae, dividing the intervariceal areas into squares of varying size; protoconch of one turn and a half, smooth, polished, blunt; adult whorls about five, slightly convex; mouth elongate-ovate, enamelled internally; outer lip varicose; columella curved, distinctly angled at junction with canal which is moderately open, reflected, notched. Height 10, diam. 4.25 mm. Rare. Gulf St. Vincent, deep water; Back-

stairs Passage 17 fathoms. Also Rottnest Lsland, W.A. (Type locality—Gulf St. Vincent, deep water). The shell has an inner hard enamel-like layer, and an outer of soft, porous, chalky consistence, much like *L. goldsteini* Tenison-Woods; otherwise it is more slender, with varices more curved, closer, whorls less angulate, less ventricose.

L. longior Verco 1909 (*Trophon*). "The Attenuate Litozamia." Narrowly spindle-shaped; white, just tinted with brown; deeply scorched spirally on the axial ribs near the suture, and in the body-whorl just below the periphery; axial ribs, bold, eleven in the penultimate, rather wider than the interspaces, round, extending from the suture which they undulate to the canal, whose varix they scale; spirals, four in the penultimate, three in the earlier whorls, nine in the body-whrol, round, crossing the axials; protoconch of two-and-a-half whorls, smoothly granular, ending by a distinct scar; first whorl with two keels, of which the highest continues as a sharp-corded angulation through the embryonic whorls, the lower fades out on the first whorl; adult whorls four and a half, convex; outer lip thin, simple; columella angled at its junction with the canal; inner lip thin, erect anteriorly; canal nearly as long as the obliquely oval mouth, directed obliquely to the left, concave to the right, slightly recurved. Height 6.4, diam. 2.7 mm. (Type locality—off Beachport, 40 fathoms, two examples). Also Ellensbrook, W.A., beach, two immature, one having a bright reddish-brown dot at the apex of the protoconch. Resembles *L. rudolphi* Brazier in its type of protoconch, but is longer, and narrower, and has its axials and spirals not so broad and close-set.

Benthoxystus Iredale 1929. Elongate, roughened by the profuse sculptural decoration; varices thin, scalloped by the spirals, and developing sharp points on the shoulder; protoconch of two-and-a-half whorls, long, conical, smooth, mouth oval, shielded by the youngest varix; columella excavate; canal short, wide. Type—*Trophon columnarius* Hedley 1908. Distinguished by its frilled axial laminae, very long spire, very long protoconch and short canal.

B. columnarius Hedley & May 1908 (*Trophon*). Pl. 1 fig. 9. "The Pillar-like Benthoxystus." Pale yellow, with brown on the protoconch, a basal and sutural band; varices thin, projecting, nine to a whorl, scalloped by the spirals, and with sharp points on the shoulder; varices almost vanish on the base; spirals, twelve on the body-whorl, crowded on the base; very faint axial threads and fainter spiral scratches between the varices. Height 20, diam. 8mm. Dredged Beachport, Cape Jaffa 40-200 fathoms;

Gulf St. Vincent, depth not recorded. (Type locality—100 fathoms off Cape Pillar, Tasmania). Some specimens show a spiral band about the middle of the shell, and another halfway between this and the protoconch, less opaque than the rest of the shell, and they are sometimes constricted along these lines and swollen between them.

B. petterdi (Brazier M.S.) Crosse 1870 (*Trophon*) (= *Trophon clathratus* Tenison-Woods 1875). "Petterd's Benthoxystus." Dull, yellowish-white, light yellowish within the mouth; there may be colour bands, just below the suture, centre of last whorl, and round the base, or there may only be the lower two, or only the lowest; axial rib-like varices, rounded, crossed by spirals, almost producing a trellised effect; protoconch, first one-and-a-half whorls smooth, last whorl with a faint spiral, ending in a scar; adult whorls four, convex; mouth ovate; the varixed outer lip having a few denticles within; canal short. Height 9,, diam. 4 mm. General in South Australia, beach to 200 fathoms. Not uncommon. Middleton specimens are rather larger and more robust than most. (Type locality—Tasmania, North). A cancellated shell, yellowish-white, almost shading to brown.

B. recurvatus Verco 1909 (*Trophon*). "The Recurved Benthoxystus." Fairly solid, sharply angulate; uniform light-horn; axial lamellae, thirteen in the penultimate, folded into prominent scales at the angle, also in the body-whorl, at a spiral cord (which starts at the suture from the back of the aperture, runs round the base, and angulates the outer lip) and then crenated, run over three obsolete spirals winding round the base, and finally bend in turn to the right over the back of the canal; protoconch, prominent, conical, of two-and-a-half smooth, convex turns, separated by a deep suture, apex curiously outstanding; adult whorls four-and-a-half, swollen, sharply angulate just above the middle; base rapidly contracted; sutures oblique, mouth roundly oval; outer lip thickened, equidistantly biangulate; canal about as long as the mouth, markedly recurved. Height 6.7, diam. 3.6 mm. (Type locality—200 fathoms, off Beachport).

Apixystus Iredale 1929. Ovately spindle-shaped; varices close, frilled, with a claw on the angled shoulder and two smaller claws below the periphery; protoconch of two turns, conical, smooth, rounded; mouth rounded; outer lip projecting in a broad squamose varix; canal short. Type—*Trophon stimuleus* Hedley 1907. Iredale made this a subgenus of *Gemixystus* Iredale 1929, which apparently does not occur in South Australia, the chief distinction being the protoconch which in *Gemixystus* is truncate and angulate.

A. stimuleus Hedley 1907 (*Trophon*). Minute, thin, prickly, angled at the shoulder; white; varices twelve, thin, close, laminate, oblique, produced on shoulder in a claw projecting to the suture and two lesser ones below the periphery, the shoulder folds rise in hollow thorns; varices cease on base; protoconch glossy of two whorls, conical; adult whorls three; outer lip projecting in a broad scaly varix; inner lip expanded; canal short, broad, open. Height 3.5, diam. 2.1 mm. (Type locality—80 fathoms off Narrabean, N.S.W.).

A. segmentatus Verco 1909 (*Trophon*). Pl. I, fig. 10. "The Bordered Apixystus." White, with a narrow brown band immediately above the suture, and from behind the mouth, round the base, to the lower part of the outer lip; sculpture elaborate—axial laminae, twelve in the penultimate, rather solid, imbricating, coronating the angle with rather long, open tubiform scales, curving up and back, and frilled with recurved valid scales distributed in spiral rows as though along spiral lirae, two in each spire-whorl and ten in the body-whorl; spirals more numerous, nine in the body-whorl; protoconch of two smooth convex whorls, with a deep suture; adult whorls five, boldly angled above the middle and constricted towards the simple suture; base gradually contracted to a moderately long snout; mouth roundly oval; outer lip thin, corrugated; inner lip a complete, prominent, erect lemella; canal as long as the mouth, slightly deviated to the left, and not recurved. Height 8.5, diam. (without the long scales) 3.5 mm. Dredged, off Cape Jaffa, Beachport, Neptune Islands, 90-300 fathoms, also Great Australian Bight (West of Eucla) 50-120 fathoms. (Type locality—90 fathoms off Cape Jaffa).

A. plicilaminatus Verco 1909 (*Trophon*). "The Spirally-folded Apixystus." Thin, long, narrow; dull white; axial lamellae, fifteen in the penultimate, erect, imbricating, projecting at the angle in long, open, tube-like upward-curving scales and below this folded in two spiral lines, two on the spire whorls, four on the body-whorl; protoconch of two smooth, convex, prominent whorls; adult whols six, convex, swollen, angled above the middle, contracted towards the distinct simple suture; body-whorl concavely produced into a long, narrow snout; mouth oval, wider above; canal long, narrow, not recurved. Height 13.9, diam. 5.3 mm. (Type locality—150 fathoms off Beachport).

Anatrophon Iredale 1929. Narrowly spindle-shaped, angled at the shoulder; varices continuous, low, broad, solid, numerous; spirals faint; spire long; protoconch of two turns, smooth, pointed; canal short, rather straight. Type—*Trophon carmentosus* Hedley & May 1908. Iredale considers the varicose sculpture as recalling that of *Galfridus*, whose relation he thinks

it might be. It is not much like the obsoletely varicedd *Galfridus eburneus* Petterd of the Flindersian region.

A. sarmentosus Hedley & May 1908 (*Trophon*). Pl. 1, fig. 11. "The Twiggy Anatrophon." Small, thin, rather glossy, angled at the shoulder; pearl grey, rust stained on the base, protoconch, and sometimes a line just below the suture; varices, ten, broad, solid, equal in breadth to their flat smooth interstices, continuous perpendicularly from whorl to whorl; on the shoulder the varices develop a pointed tubercle; spirals indistinct, cross the varices on the base; protoconch, two-whorled, smooth, pointed; adult whorls four; mouth oval; from the base of the columella projects the inner side of the short, rather straight, canal. Height 5, diam. 2.15 mm. Off Beachport, 110 fathoms. (Type locality —seven miles east of Cape Pillar, Tasmania, 100 fathoms).

A. latior Verco 1909 (*Trophon*). "The Broad Anatrophon." Solid, ovately fusiform; horn-tinted, with a white spiral line at the angle, and a broad brown band below the periphery; the most anterior spiral on the varix of the canal articulated brown, the one above it wholly white; sculpture bold; anxial ribs, ten in the penultimate, high, compressed, rounded, narrower than the interspaces, extending from the suture to the varix of the canal; spirals, three on the spire-whorls, nine on the body-whorl, crossing the axials; protoconch of two-and-a-half whorls, smooth, convex, ending abruptly, apex exsert; adult whorls four-and-a-half, convex, sharply angulate above the centre; body-whorl roundly angled at the periphery, very contracted at the base; mouth oval, oblique; outer lip thin, simple; canal moderate recurved, open. Height 7.2, diam. 3.9 mm. Dredged, off Beachport, Cape Borda, Cape Jaffa, 40-150 fathoms. (Type locality—40 fathoms off Beachport).

Enatimene Iredale 1929. Regularly spindle-shaped, more or less obsoletely trellised; medium length spire; protoconch two-whorled, small; mouth free; canal long, straight, open, recurved. Type—*Trophon simplex* Hedley 1903.

E. simplex Hedley 1903 (*Trophon*). Pl. 1, fig. 12. "The Natural Enatimene." Cinnamon-brown, paler at the protoconch and canal; spirals, strong, on the early whorls two, then three, and about eight on the body-whorl; axial ribs, more or less bold, commence on the antepenultimate, sometimes fading away on the later whorls, cross the spirals, producing nodules; a strong outstanding varix behind the outer lip; mouth oval, smooth within; inner lip projecting as a narrow rim free from the body-whorl; canal long, straight, open. Height 8, diam. 3.8 mm. 35 miles S.W. of Neptune Islands, Cape Jaffa, Cape Borda, Beachport, 55-300 fathoms. Rare. (Type locality—off Port Kembla, N.S.W., 63-75 fathoms).

Emozamia Iredale 1929. Short, squat, obliquely biconical, angled at the shoulder, cancellate; axial and spiral lirae, scaly, imbricated, lamellose, with deep spiral grooves cut up rather squarely; spire rather short; protoconch few-whorled, pointed, oblique; mouth triangularly oval, large; outer lip expanded; canal short, widely open. Type—*Murex licinus* Hedley & Petterd 1906.

E. flindersi Adams & Angas 1863 (*Purpura*). Pl. 1, fig. 7. "Flinders' Emozamia." Greenish-white; widely cancellated by axial and spiral lirae, scaly, lamellose, imbricated; spire somewhat elevated, conical; protoconch about one-and-a-half whorls, indistinct, slightly oblique; adult whorls five, angulated above the centre, last whorl anteriorly contracted; mouth triangularly-oval, outer lip violet-brown within, with pale spiral lirae, margin white and crenated; inner lip nearly flat, tinted brownish-violet; operculum distinctly muricoid. Height 45, diam. 36 mm. All round the coast of South Australia, on rocks, from high to low tides. Not common. Also Albany W.A. beach, measuring 22.5 mm. (Type locality—Yorke Peninsula S.A.). A cancellate species, with the interior stained rich violet-brown, and the edge of the outer lip white.

E. levis Verco 1895 (*Trophon*). "The Smooth Emozamia." Thin; dull white; axial riblets, nine, low, broad, rather rude, irregular; spiral elevations, obsolete, broad, flat; protoconch indistinct, one-and-a-half turns slightly oblique; adult whorls about five-and-a-half; body-whorl scarcely ventricose, uniformly rounded; suture distinct, irregular, somewhat crenulated by growth lines; mouth ovate, contracted above, opening widely into the short canal; outer lip simple, thin, crenulate; inner lip, callus thin, slightly spreading; umbilicus, a chink; operculum muricoid. Height 27.5, diam. 16 mm. Backstairs Passage, 22 fathoms. There is a complete, thin, soft chalky coating which obscures the sculpture, but is evidently not an adventitious deposit. From *E. flindersi* this shell is much thinner, narrower, spire more acute, whorls less angulated, outer lip thin, not denticulated, columella not so excavated, umbilicus smaller, canal more open; surface much less sculptured. It is possibly only a deep water variety of *E. flindersi.*

Bedeva Iredale 1924. Ovately spindle-shaped, whorls angular above; axial ribs rather prominent; spiral striae, many; protoconch few-whorled, oblique; mouth ovate; outer lip thin, acute; canal long, oblique. Type—*Trophon hanleyi* Angas 1867. South Australian shells of this genus are found under stones in the mud-zone of estuaries and sheltered waters. They are destructive to young oysters. The eggs are deposited on the under-

side of shells and stones, each in a separate capsule, of about a quarter inch, crowded, rather flatter than round, with a central circular orifice. The egg can be seen both through the orifice and through the semitransparent membrane.

B. assisi Tenison-Woods 1876 (*Trophon*) (= *T. squamosissima* Tenison-Woods 1878). Pl. 1, fig. 13. Greyish-olive under a greenish covering; interior purple; axial ribs, thick, broader than the interstices, about nine in the last whorl, scaly, and with very fine axial lamellose striae; spiral lirae, conspicuous, large and small lirae alternating, and passing over the ribs; protoconch of barely two whorls, striate; adult whorls five, convex, angular above; suture impressed; canal long, recurved. Height 30, diam. 15 mm. Shallow water in estuaries and sheltered inlets; rather common, Port Adelaide River. West to Fremantle. (Type locality—North Coast, Tasmania). Some are convex and not angulated, the ribs scarcely visible, and the axial lamellae very close and high. *B. squamosissima* Tenison-Woods, is probably a juvenile *assisi*; young shells appear most intensively scaly.

B. paivae Crosse 1864 (*Trophon*) (= *Fusus recurvus* Philippi 1846: = *Trophon australis* Tenison-Woods 1875... "The Baron of Paiva's Bedeva." Solid, greenish-yellow; axial ribs strong, broad, round, crossed by numerous spiral striae; adult whorls about six, angulated above, convex; last whorl a little longer than the spire; mouth roundly oval, yellow or purple within; outer lip simple, six denticles within; columella nearly straight, slightly excavated; canal rather long, recurved; usually with a slight umbilical cleft. Height 26.5, diam. 13 mm. Under rocks and small boulders at low-water and in sheltered backwaters. Common at Snowden's Beach (Outer Harbour), Ardrossan, Port Wakefield. Also dead shells dredged Gulf St. Vincent, 9 fathoms. (Type locality—Yorke Peninsula, under stones). Very variable; they are long and slender on the Outer Harbour mud flats, shorter and more solid on the rocks situated about low-tide mark.

THAIDIDAE.

"Whelks." Strong, without varices, mostly with nodules or tubercles; siphonal canal wanting or only very short, the base usually deeply notched; columella flattened, little excavate, sometimes plicate; operculum horny, lamellate, nucleus external, lateral. Distribution—World-wide, from low-water to very moderate depths. Fossil—Tertiary.

Animal does not differ essentially from that of the *Muricidae*; foot moderate, obtuse behind; eyes usually placed near the tips of the tentacles; siphon short. Gregarious, mostly living on rocks at about low-tide mark; carnivorous, and destructive of oysters, mussels, limpets and other molluscs both bivalve and univalve, which it bores with the radula. The hole bored is like an inverted cone and exhibits under the microscope extremely fine scratch-like striae. The ancients obtained a dull crimson dye from *Purpura lapillus* Linne (Europe), by pressing the operculum. While many of the shells in this family are quite distinct from those of the *Muricidae*, there are some which approximate to them, but they are distinguished by the operculum, the nucleus of which is at the side (about the middle) in *Thaididae* and at, or near, the end in the *Muricidae*.

Neothais Iredale 1912. Ovate, solid; spiral ribs flatly convex, composed of fine spiral threads, more or less cut up into nodules by axial grooves; spire conic, not so high as the mouth; protoconch oblique, sinusigerous, horny, sharply conic, polygyrate, swollen at its base; body whorl very large, rounded; mouth scarcely oval, produced below into a short, open, deeply notched canal; outer lip convex, dentate-lirate within; operculum horny, with nucleus at the side. Type—*Purpura* (*Polytropa*) *smithi* Brazier 1889 (Lord Howe Island).

N. textiliosa Lamarck 1822 (*Purpura*) (not *N. succincta* Martyn 1784, from Eastern Australia). Pl. 1, fig. 14. "Common Whelk." Large, ovate, ventricose, solid; yellowish-white, with a band of deep yellow, within the outer lip, often bordered by a narrow band of white; sometimes pinkish-yellow above the basal notch; spiral ribs about ten, rounded, faintly cut up by the obsolete axial grooves; the whole surface crowded with small round spirals, crossed by fine growth lamellae; sculpture is sometimes obsolete; protoconch small, of about two-and-a-half turns, convex, smooth; last adult whorl large, ventricose; mouth large, oval; outer lip convex, thick, grooved inside; inner lip white, not broad; operculum dark-brown. Height 80, diam. 50 mm. South Australian specimens may reach 90 x 55 mm., or 86 x 58 mm. All round the South Australian Coast, gregarious, on rocks at low water. Common. Also Western Australia. (Type locality—Australia). Really confined to the Flindersian region. The Peronian (Eastern Australian) species *N. succincta* Martyn has usually valid, unbroken, cord-like spirals (about eight in the body-whorl) not seen in the South Australian *N. textiliosa*; the latter may become somewhat rugose with broken spirals under

extreme conditions. Specimens approaching *N. succincta* Martyn have been taken at Venus Bay. (Type locality of *N. succincta* Martyn—New South Wales).

N. baileyana Tenison-Woods 1881 (*Purpura*). "Bailey's Neothais." Ovate, thick; dull pale olive; spiral ribs conspicuous, close; axial lamellae very fine, wavy; growth lines almost varice-like, thick, irregular; spire short, conical; whorls five, the last very large, ventricose; mouth oval, white, shining; outer lip thick, crenated, broadly grooved within; inner lip broad, curved; canal a deep groove. Height 30, diam. 19 mm. Beachport, MacDonnell Bay, also Guichen Bay but apparently no further west. On rocks, rare. (Type locality—Victoria). Type in S.A. Museum. Possibly an extreme form of *N. textiliosa* Lamarck.

Lepsiella Iredale 1912. Ovate-oblong, turreted; spiral ribs strong, one only very strong medial keel on the spire-whorls, and two distant strong keels on the body-whorl (the type has often a third lower keel as strong as the others); axial ribs are strong when present, sparse (9-10) and produced into thick, more or less spinose nodules on periphery; the whole surface covered with minute laciniate frills instead of regular axial lamellae; spire moderate, conical; protoconch paucispiral, rather tall, rather loosely coiled, the whorls somewhat globose, smooth; adult whorls shouldered; suture impressed; mouth slightly oblique, oval, angled above; outer lip sharp, crenate, lirate within; canal short, open, slightly recurved; operculum, nucleus sublateral. Type—*Purpura scobina* Quoy & Gaimard 1833 (New Zealand).

L. reticulata Blainville 1832 (*Purpura*) (= *Purpura humilis* Crosse 1865). "The Netted Lepsiella." Nearly oval, somewhat angular, rather thick; pinkish, with large brown spots on the nodules; spiral ribs numerous, small; axial striae, fine, appearing only in the intervals between the spiral ribs; spire conic, somewhat elevated; protoconch of one-and-a-half turns, smooth, yellowish; spire whorls bear a zone of brown rather distant nodules, forming a keel; body-whorl, longer than the spire, angulated, with rows of similar brown nodulations; mouth oval-oblong, somewhat angular, pinkish, marked inside with a few rays; outer lip simple, subangulated medially. Height 12, diam. 6 mm. All round the coast of South Australia; beach and down to 110 fathoms, (mostly not beyond 20 fathoms). Not common. (Type locality—Gulf St. Vincent.) Also Western Australia—Esperance, Ellensbrook, Yallingup, Hopetown.

Lepsithais Finlay 1926. Strongly squamose; differs from *Lepsiella* in having two main spiral cords on the spire-whorls (with a third weak one, present or absent, above them) and eight regular thick spirals on the body-whorl, smooth except for the

axial lamellation; axial ribs, if present, are numerous (12-16), weakly developed, and not spinose. Protoconch similar to that of *Lepsiella*. Type—*Polytropa squamata* Hutton 1878 (New Zealand).

L. vinosa Lamarck 1822 (*Buccinum*) (= *Ricinula adelaidensis* Crosse & Fischer 1865: = *Purpura littorinoides* Tenison-Woods 1875: = *P. propinqua* Tenison Woods 1876: = *Cominella albolirata* Tenison-Woods 1878. Pl. 1, fig. 15. *vinosa* = full of wine). Oval, thick, scaly, spire elevated; whitish, usually covered by a green coating; axial ribs, rugose, lamellose, crossed, so as to form a sort of rough coarse network, by about eight rather projecting spiral ribs; adult whorls five, slightly convex, and the absence of spiral ribs just below the suture, makes them appear keeled; body-whorl rather longer than the spire; mouth narrowly oval, deep wine-colour; outer lip stoutly thickened, about five whitish tubercles inside at some distance from the edge; inner lip tinged whitish inside; operculum reddish-brown, nucleus sublateral. Height 26, diam. 14 mm. All round the coast of South Aupstralia, on rocks at low-water. Rather common. Also Western Australia, Albany; does not appear to occur beyond C. Leeuwin. (Type locality—the seas of New Holland [Peron]). Very variable and has an extensive synonymy. Exceptional specimens have the axials coalesced, with as few as four very wide and high with second axials on them; others with very narrow axials up to fourteen, while in others they are nearly obsolete; so the spiral cords in some are very valid and nearly equal, in others they are obsolete or unequal. **L. aurea** Crosse & Fischer 1865 is a colour variety and differs in its pale yellow mouth, which takes on the inside an orange tinge. It was also described as a little smaller than *L. vinosa,* but we have taken both of the largest size from the same rock at the Outer Harbour. Fairly common, on exposed rocks. (Type locality—Port Adelaide and Gulf St. Vincent).

L. adelaidae Adams & Angas 1863 (*Adamsia*). "The Adelaide Lepsithais." Reddish-brown; axially densely lamellose; spiral lirae, valid, nodulous, (six in last whorl); spire elate, longer than the mouth; whorls seven, convex; mouth ovate, subrostrate anteriorly; outer lip curved, margin rather thickened, scarcely reflexed; inner lip simple. (Type—Height 16, diam. 6.5 mm.; locality—Port Adelaide). Probably a narrow attenuate rather smooth form of *L. vinosa* Lamarck.

Tolema Iredale 1929. Biconical, spire tabulate; axial ribs numerous, obscure, marked by lines of erect scales; shoulder angle, a line of sub-tabular imbricating scales forming an erect

hood; numerous spiral lines of smaller scales; protoconch sinusigerous, of five turns, with four keels on last whorl, two of which ascend the spire, the first two whorls smooth, the others crossed obliquely by lamellae which cross the keels; outer lip thickened, reflected; canal produced, sinuate. Type: *Purpura sertata* Hedley 1902.

T. sertata Hedley 1902 (*Purpura*) (not *Coralliophila lischkeana* Dunker 1882 [*Rapana*] from Japan). Biconical; faint pinkish, scales white; axial ribs, seven, obscure, marked by erect scales (when beach-rolled only distant axial ribs appear); shoulders of whorls subtabular with imbricating scales, beneath are six spiral lines of much smaller scales connected by lamellae with the scales above and below; two similar spirals between suture and shoulder; protoconch sinusigerous, of five turns, with four keels on last whorl, two of which ascend the spire, the first two whorls smooth, the others crossed obliquely by numerous delicate lamellae which chose the keels; (when rolled the keels are rubbed off the protoconch leaving the whorls smooth, round) adult whorls three; mouth triangularly oval; outer lip thickened, reflected. Height 9 diam. 4.5 mm. Dredged, Beachport to Bunbury 22-300 fathoms. (Type locality: Port Kembla, N.S.W. 63-75 fathoms.)

Rapana Schumacher 1817. *Rapa* = a turnip. Ventricose, axis perforated to the apex; spire not much elevated; mouth oval narrowed below; canal open, slightly recurved; inner lip reflected, free anteriorly; umbilicus wide, corrugated; operculum horny, lamellar, nucleus external, sublateral. Type: *R. bezoar* Linne (Japan).

R. mira sp. nov. pl. 1. fig. 16. "The Admirable Rapana." Previously mistaken for *Coralliophila elaborata* H. & A. Adams 1863 from the Sandwich Islands. We describe it as a new species. Biconic; white, deep mauve within the mouth and on the columella; axial ribs, regular, broad, rounded, twelve on body whorl, fading on the early whorls; spiral riblets narrow, close, encircling the whole shell and passing over the axial ribs and interstices; spire conical, about two-fifths of total length; protoconch eroded, apparently smooth; adult whorls five, flat-sided, last roundly shouldered; mouth rather wide, ovate-oblong; outer lip obscurely, finely, denticulate by the spirals; umbilicus narrow for the genus; operculum ear-shaped, horny, lamellar, nucleus external, sublateral. Height 26 diam. 16 mm. St. Francis Island in rock pools between tide-marks. (Reg. No. D 10601 S. Aus. Mus.) St. Francis Island, S.A. to Ellensbrook, W.A. In place of mauve some specimens are white within the mouth and on the columella.

R. nodosa A Adams 1853 (Latiaxis) (= *Coralliophila wilsoni* Pritchard & Gatliff 1897: not *C. rubrococcinea* Melville & Standen 1901, from the Persian Gulf.) "The Nodulous Rapana." Biconic, short; white; spiral lirae over entire surface, fine crowded; whorls five, roundly angulated, bearing about ten large, rounded nodules on the shoulder; mouth pyramidal; canal short, tortuous; umbilicus wide, its margin serrated; aperture buff, sometimes purple. Height 20 diam. 11.5 mm. All along the South Australian and Western Australian coasts to Rottnest Island, beach, and down to 130 fathoms; uncommon. (Type locality—Philippines, probably incorrect; Port Jackson [Hedley])

ELLOBIIDAE.

Spiral, ovate, solid, periostracum horny; spire usually short; last whorl large; base rounded; mouth elongate; outer lip sometimes dentate; inner lip with strong tooth-like folds; inner walls of the whorls usually absorbed, forming a single cavity. Distribution—Australasia, Pacific, South America. Fossil—Jurassic. Animal—head ending in a snout; tentacles sub-cylindrical, contractile; eyes sessile at the inner sides of their bases; mantle closed, with a thickened margin; respiratory orifice posterior, on the right side; foot ovate, obtuse behind; mouth with an upper horny jaw, and with two buccal lobes, united above, separate below. Sexes united in the same individual. Usually frequent salt marshes, but sometimes terrestrial.

Marinula King 1831. Ovate-oblong, imperforate, solid, smooth; spire short, conic; mouth scarcely oval; outer lip sinuous above, simple arcuate; columella flattened, with two or three folds, the upper one very large, obliquely descending, the lower two smaller and less oblique. Type—*Marinula pepita* King 1831.

M. meridionalis Brazier 1877 (*Auricula, Alexia*) (= *A. harrissoni* Beddome 1882). "The Meridional Marinula," apparently so called from the varicea rib down the centre of the back of the body whorl. Oblong-ovate, thin, transparent, imperforate; light-horn colour, peristome and columella white; axially striate, otherwise smooth; usually a varix, the remains of an old mouth, in the centre of the back of the body whorl; spire acuminate; protoconch papillate; whorls seven, slightly convex; suture impressed; base rounded; mouth vertical, narrowly ovate, as long as the spire; outer lip slightly reflected; inner lip with three folds. Height 8 diam. 4 mm. Port Adelaide River, under shrubby-samphire, just above high-water mark; not uncommon. (Type locality—Port Adelaide River, in swamps.)

M. xanthostoma Adams 1854 (not *M. patula* Lowe) 1831 (*Melampus*). Pl. 3, fig. 1. Ovate-oblong, solid, shining, reddish-yellow, mouth yellow; rather smooth; spire acute, as high as the mouth; whorls five, somewhat convex, last large, rounded; mouth oblong-ovate, angled above, rounded below; outer lip acute somewhat thickened medially, sinuate above; columella with three tooth-like folds, the highest the largest. Height 10 diam 6 mm. All round the coast from Macdonnell Bay, S.A. to Fremantle, W.A. Beach, not common. (Type locality—Moreton Bay, Queensland.)

M. parva Swainson 1856 (*Cremnobates*). "The Small Marinlua." Ovate, thin, light; whitish or light brown, mouth brown; growth lines well marked; spire conic, about as high as the mouth; protoconch minute, pointed; adult whorls four; last very large, convex; mouth vertical, ovate, angled above, rounded below; columella with two strong folds, the upper one larger, high up. Height 7.5 diam. 5 mm. American River, Kangaroo Island. Beach, rare. (Type locality—Oyster Cove, Hobart.)

Ophicardelus Beck 1837. Ovate-ablong; spire elevated, subconic; mouth oval; outer lip simple, without teeth; columella with two folds, the lower oblique, the upper horizontal and prolonged exteriorly, forming a periumbilical keel. Type—*Auricula ornata* Ferussac 1821 = *A. australis* Quoy & Gaimard 1833.)

O. ornatus Ferussac 1821 (*Auricula*) (= *Auricula australia* Quoy & Gaimard 1833: = *Cremnobates cornea* Swainson 1856) Pl. 3 fig. 2. "The Ornate Orphicardelus." Ovate-conic, rather solid, sometimes with an umbilical chink; yellowish or light-brown, with one or several dark-brown spiral bands; growth lines distinct, also some times axial ribs, flattish, numerous, irregular; a narrow groove below the suture; periostracum horny, thin, shining; spire conical, about as high as the mouth; protoconch very small, usually eroded; adult whorls nine, slightly convex, the last large, ventricose, convex; mouth subvertical, narrowly ovate, angled above; outer lip sometimes with an outer varix, smooth inside; columella folds two, the upper horizontal at junction with parietal wall, the second oblique, lower; inner lip a thin shining glaze; sometimes an indistinct umbilical chink present. Height 13.5 diam. 7 mm. (Type.) Recorded from South Australia by Adcock, but we have not seen specimens. Also Victoria and Tasmania. In brackish water and mangrove swamps. (Type locality—New South Wales.)

PLATE 1.

Fig. 1—*Pteronotus angasi* Crosse.

Fig. 2—*Pteronotus triformis* Reeve.

Fig. 3—*Murexsul umbilicatus* Tenison-Woods.

Fig. 4—*Galfridus eburneus* Petterd.

Fig. 5—*Cyphonochelus syringianus* Hedley.

Fig. 6—*Typhis yatesi* Crosse.

Fig. 7—*Emozamia flindersi* Adams & Angas.

Fig. 8—*Litozamia rudolphi* Brazier.

Fig. 9—*Benthoxystus columnarius* Hedley & May.

Fig. 10—*Apixystus segmentatus*. Verco.

Fig. 11—*Anatrophon sarmentosus* Hedley & May.

Fig. 12—*Enatimene simplex* Hedley.

Fig. 13—*Bedeva assisi* Tenison-Woods.

Fig. 14—*Neothais textiliosa* Lamarck.

Fig. 15—*Lepsithais vinosa* Lamarck.

Fig. 16—*Tolema mira* sp. nov.

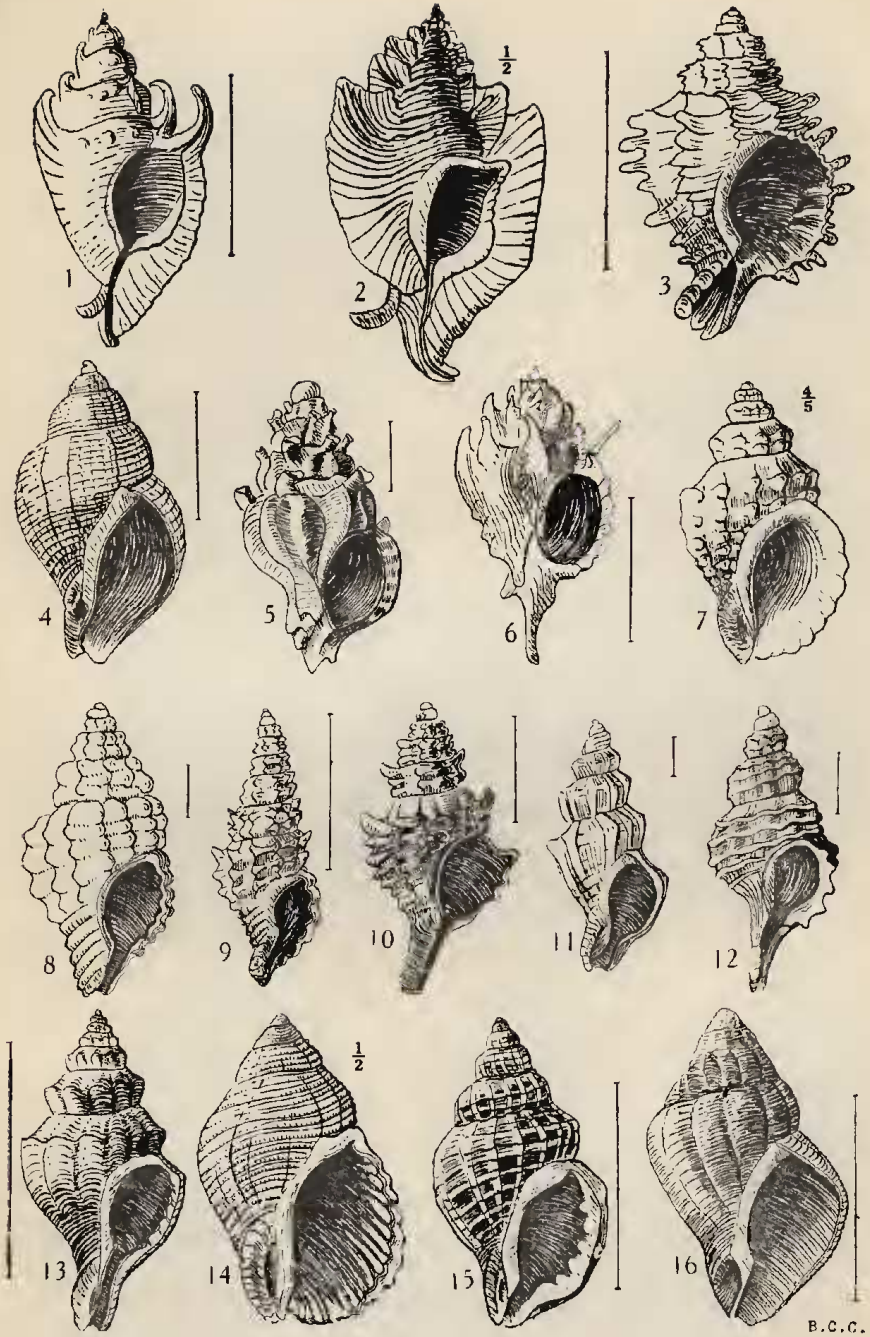
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PLATE 2.

Fig. 1—*Myxas papyracea* Tate.

Fig. 2—*Limnaea subaquatilis*. Tate.

Fig. 3—*Limnaea lessoni* Deshayes.

Fig. 4—*Isodorella newcombi* Adams & Angas

Fig. 5—*Isodorella inflata* Adams and Angas.

Fig. 6—*Ameria tenuistriata* Sowerby.

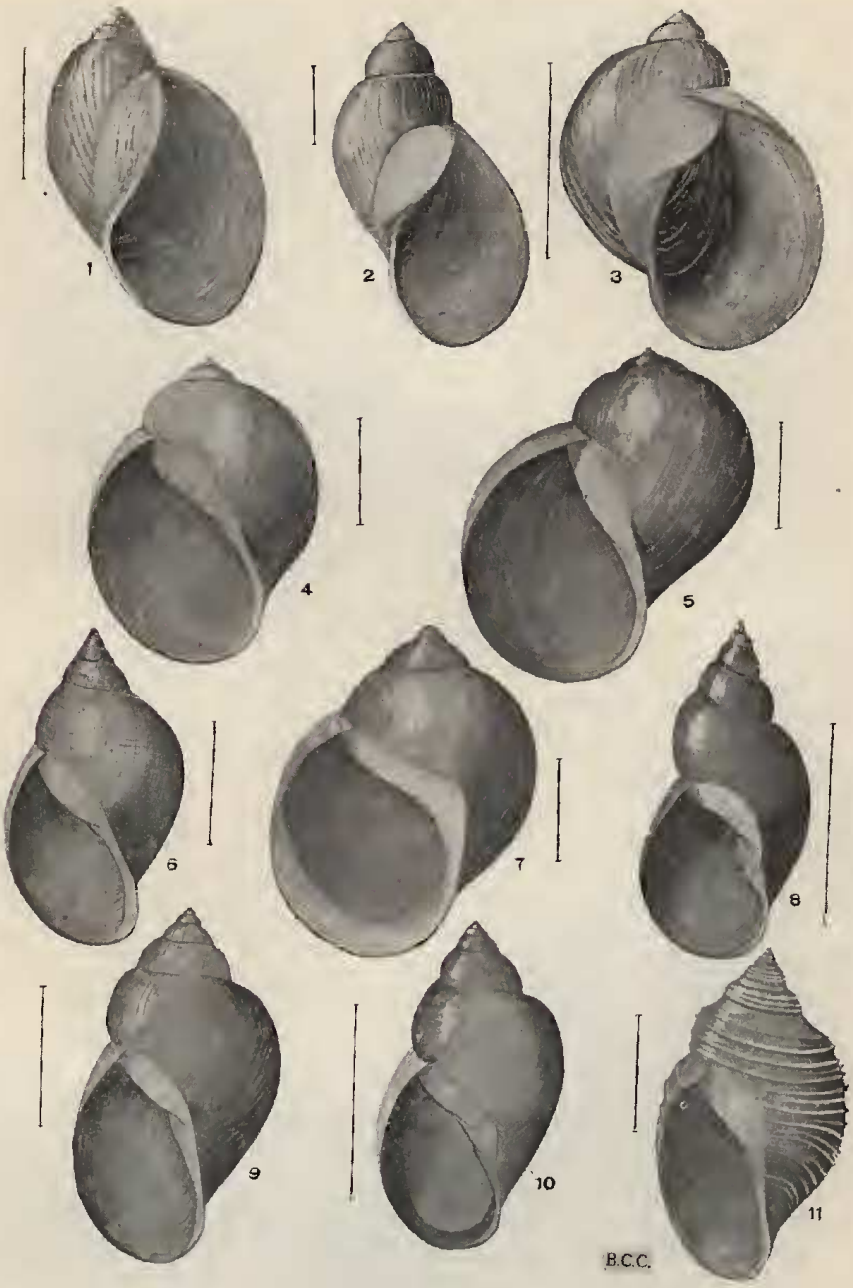
Fig. 7—*Isodorella rubida* Tate.

Fig. 8—*Ameria pyramidatus* Sowerby.

Fig. 9—*Ameria bullata* Sowerby.

Fig. 10—*Ameria pectorosa* Conrad.

Fig. 11—*Ameria aliciae* Reeve.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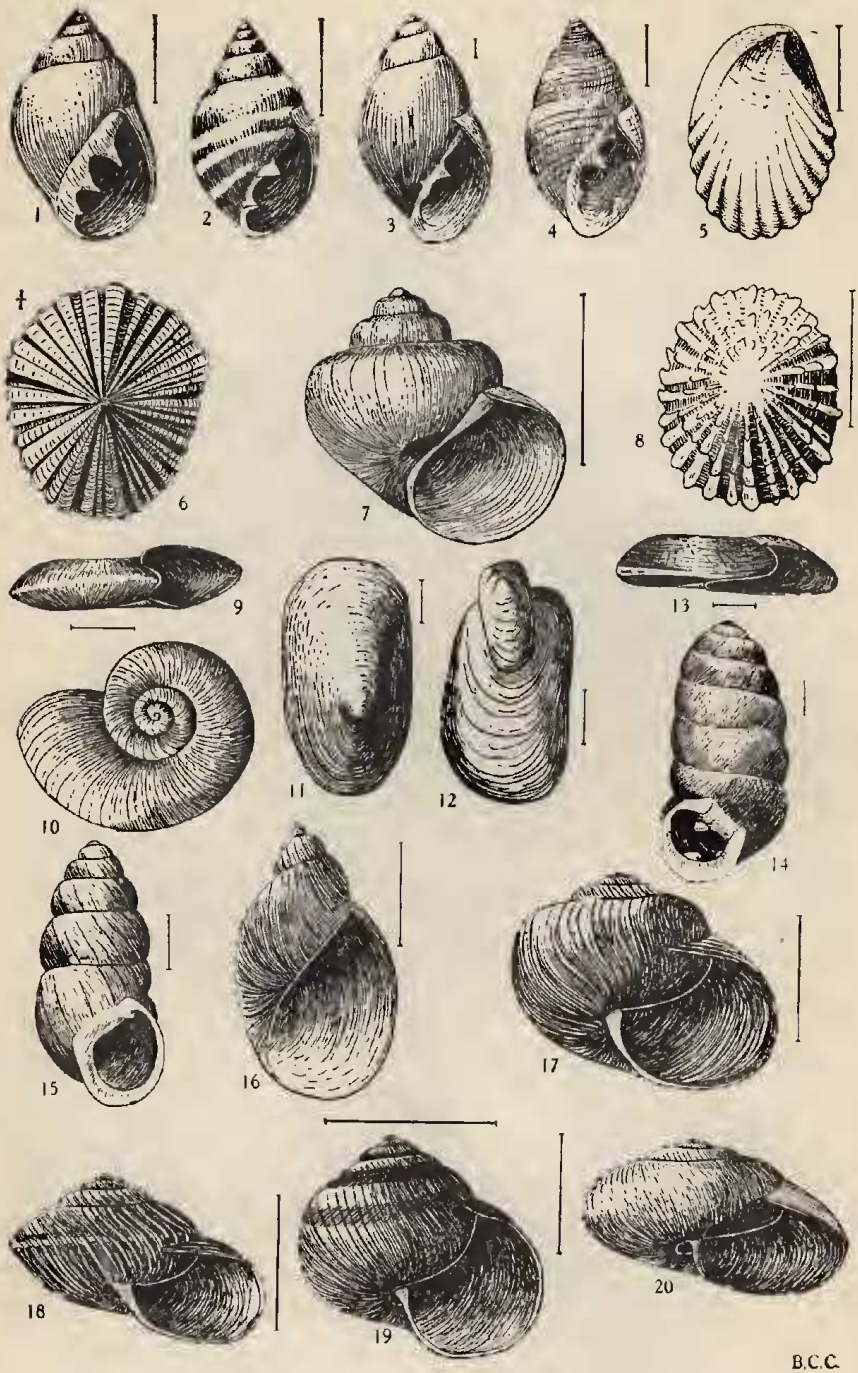
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PLATE 3.

Fig. 1—*Marinula xanthostoma* Adams.

Fig. 2—*Orphicardelus ornatus* Ferussac.

Fig. 3—*Leuconopsis pellucidus* Cooper.

Fig. 4—*Plecotrema ciliata* Tate.

Fig. 5—*Pugillaria stowae* Verco.

Fig. 6—*Siphonaria diemenensis* Quoy & Gaimard.

Fig. 7—*Salinator fragilis* Lamarck.

Fig. 8—*Gadinia conica* Angas.

Fig. 9—*Planorbis isingi* sp. nov. (lateral view).

Fig. 10—*Planorbis isingi* sp. nov. (dorsal view).

Fig. 11—*Ancylus australicus* Tate.

Fig. 12—*Gundlachia petterdi* Johnston.

Fig. 13—*Segmentina victoriae* Smith.

Fig 14—*Pupilla australis* Angas.

Fig. 15—*Pupoides adelaidae* Adams & Angas.

Fig. 16—*Succinea australis* Ferussac.

Fig. 17—*Notobadistes fodinalis* Tate.

Fig. 18—*Glyptorhagada silveri* Angas.

Fig. 19—*Notobadistes bitaeniatus* Cox.

Fig. 20—*Rhytida gawleri* Brazier.

Leuconopsis Hutton 1884. Ovate, ablong, imperforate acute, smooth inside; inner lip with one fold, strong, medial, smooth; spire conical; mouth elongate, ovate, outer lip simple, prominent, and a small low tubercle below. Type—*Leuconopsis obsoleta* Hutton 1878. (New Zealand; minute, very variable in size and shape.)

L. pellucidus Cooper 1841 (*Auricula*) (= *Tornatella minuta Petterd* 1879 = *L. victoriae* Gatliff 1905: = *L. tatei* Gatliff 1905) Pl. 3 fig. 3. "The Pellucid Leuconopsis." Minute, ovate, imperforate; opaque white; spiral grooves, faint, sometimes only on upper whorls; periostracum thin, dirty brown, showing oblique growth lines which are barely visible in the white dead shell; spire about as high as the mouth; spire whorls slightly convex, last large, convex; inner lip with a central well developed tooth-like fold, with a low tubercle below, only visible when viewed sideways. Height 2 diam. 1.4 mm. Shell sand, Fowler Bay, Moonta Bay, Brothers Island, Coffin Bay. Not common. (Type locality—Picked out of sand from Van Dieman's Land.) The position of the excentric protoconch to the right or left of the mid-line is manifestly a question of how many half whorls are formed before maturity is reached.

Plecotrema H. & A. Adams 1853. Oval-conic or subfusiform, solid, usually spirally grooved; spire conical, sharp; mouth oblong, contracted; inner lip with three folds, one of which is bifid; peristome thickened, usually varicose, bidentate or tridentate within. Type—*P. typica* Adams.

P. ciliata Tate 1878 Pl. 3 fig 4. "The Ciliated Plecotrema." Fusiformly-ovate, imperforate, solid; shining brown and black, with a narrow light coloured band near the suture and a reddish coloured one in between; many axial incised lines and regular spiral wrinkles; at the intersection of the lines, punctuatedly impressed and ciliated, the cilia yellowish-brown, thread-like; spire conic, rather pointed; whorls seven, scarcely convex with one shallow groove near the suture, the last whorls forming three-fourths of the total length; outer lip with two tubercular teeth; columella with a white tubercular tooth above and below with two compressed spiral folds; inner lip expanded and reffected to form a false umbilicus. Height 7.5 diam. 4 mm. Port Adelaide, Streaky Bay, Denial Bay, Murat Bay, Port Wakefield, Gulf St. Vincent. Not common. (Type locality—Mangrove swamps, under shrubby-samphire, just above high-water mark, Port Adelaide, in company with *Marinula meridionalis* but not so abundant as that species.)

AMPHIBOLIDAE.

Globose, umbilicated; spire short, whorls shouldered above; mouth scarcely oval; operculum horny, subspiral.

Distribution — Australasia, Polynesia, Indian Ocean. Fossil—Pliocene. Animal having a large flattened disc-shaped head, lightly sinuated in front; eyes sessile, at the bases of the two small flattened triangular tentacles; pulmonary opening on the right side; visceral mass spirally coiled. Sexes united in the one individual. Lives between tide-marks in salt or brackish water on mud-flats in sheltered bays. Very sluggish habits, feeds on vegetable matter contained in mud, disposing of large quantities in this manner. A New Zealand representative of this family (*Amphibola crenata* Martyn) although air-breathing, will live for a week or ten days in fresh water, and for more than a fortnight in salt water, without being exposed to the air.

Salinator Hedley 1900 (=*Ampullarina* of authors, not of Sowerby). Subglobose, thin, umbilicated; spire short; protoconch paucispiral, obtuse, rounded, smooth, polished; adult whorls rounded; outer lip with posterior sinus; inner lip simple; operculum horny, ovate, subspiral. Estuarine. Type—*Ampullaria fragilis* Lamarck 1822.

S. fragilis Lamarck 1822 (*Ampullaria*) Pl. 3 fig. 7. "The Fragile Salinator." Somewhat globose, semitransparent, umbilicated, solid; greyish-horn with many axial undulating light-brown flames and frequently from one to three spiral brown bands; axial lamellae imbricating, less distinct on the spire whorls; protoconch, about two turns, rounded, globose, smooth, polished; adult whorls four, ventricose, with a rounded keel at the angle of the shoulder, and another less distinct below it; suture deep; mouth almost round; outer lip strongly convex, sharp, thickened towards the base, with a shallow rounded sinus at the angle of the shoulder; inner lip somewhat expanded; umbilicus rounded, deep; operculum horny, ovate, subspiral. Height 20 diam. 21 mm. Estuarine, between tide-marks, on mud flats and in sheltered bays. Very common at Outer Harbour. Also King George Sound, Bunbury, W.A. Very variable in colour. (Type locality—King George Sound.)

S. quoyana Potiez & Michaud 1838 (*Amphibola*). "Quoy's Salinator." Resembles *S. fragilis* Lamarck, save that the spire itself is half, instead of one-third, the total height; colour also usually deeper, the zig-zag lines more pronounced and the sculpture coarser. Height 18 diam. 16 mm. Common in company with *S. fragilis*, of which it may be an exsert variety. Also Albany, Bunbury, W.A. (Type locality—"Nouvelle Zelandie" [error] Probably Kangaroo Is.)

SIPHONARIIDAE.

Conical, limpet like, muscle-impression interrupted by a lateral groove on the right side corresponding with the pulmonary orifice. Distribution—Warm and temperate seas, the majority of the species in the Southern Hemisphere; on rocks between tide-marks, like limpets. Fossil—Eocene of Paris. Animal having the head expanded, the tentacles atrophied, bilobed in front; eyes sessile on the outer sides of the disc; visceral mass conical; respiratory orifice covered by a large fleshy lobe of the mantle; aquatic, pallial cavity containing secondary branchial laminae; jaw arcuate, with simple or projecting margin and with vertical filaments above; no operculum. Sexes united in the same individual. Eggs in white gelatinous rope-like masses, attached to rocks in irregular curves, much like those of Nudibranchs.

Siphonaria Sowerby 1824. Limpet-like, inside polished summit central or nearly so; muscle-impression horseshoe-shaped, front ends united by a groove corresponding to the line of attachment of the mantle to the shell; it is interrupted on the right side by a deep siphonal groove, which produces a slight projection on the margin; external surface radially ribbed. First species—*Siphonaria sipho* Sowerby (India).

S. diemenensis Quoy and Gaimard 1833. Pl. 3, fig. 6. "The Van Diemen's Land Siphonaria." Oval, convex, somewhat high; apex central, acute; radiating ribs, about forty, small, conspicuous, rounded, ash-gray, slightly rugose; interstices dark-brown, concave, occasionally with smaller ribs which reach half-way up the shell; margin acute and finely undulating; interior regularly marked with dark-brown and white lines, the brown marks becoming broader towards the edge and often bifurcating; spatula badly defined and clouded reddish-brown; siphon not always defined. Length 25, breadth 23 mm. All along the coastline of South Australia. On rocks between tide-marks, common. An acutely convex species irregularly closely ribbed, with the interstices excavately grooved and further distinguished by the inner margin being conspicuously tessellated. The South Australian shell is very variable. It may be high and steeply conical, or so depressed as to be nearly flat. The ribs may be as few as seventeen or very numerous, distant or crowded; high, narrow, and sharp cut, or low, broad and rude; straight, smooth, and regular, or crooked, rough, irregularly noded, or scabrous. Rarely, the shells are colourless when taken alive; or yellowish, with faint smokiness between the ribs. May be brown throughout, or with bluish-white ribs and bluish-black between. (Type locality—D'Entrecasteaux Channel, Tasmania.) The following

remarks are from Tenison-Woods' observations: Animal citron-yellow beneath, dusky, speckled with yellow, above; head separated from the foot by a deep transverse fissure; base of head a pale neutral tint; mouth when closed appears as a reddish-brown spot; lower lip yellowish, when closed is like a longitudinal fissure, as it opens it becomes crescentic, the upper lip is then seen, arched, fine reddish-brown above, with yellow cirrhi below; the radula is protruded from this, and moves up and down with an ordinary licking movement; the appearance of the radula is that of the finger of a glove with the end pushed in upon itself, and the crowded edges of the tube thus formed brought together by the drawing in of the top until they unite in a rounded point, which is then drawn up; the pushing out and drawing in of the top of the "finger" from within is the manner in which it feeds, thus the free end of the tube is apparently brought backwards and forwards, and the food triturated and carried into the œsophagus. No eyes are visible. Above the foot on the right side of the animal is a lobe which forms a kind of semi-circular tube, closely pressed to the shell, and here the mantle is not visible; this tube is the siphon, and is lobed so as to be capable of a kind of bipartition which probably divides the orifice into an excretory as well as respiratory duct; this lobe of the foot acts as a kind of operculum, closing the orifice when necessary; if placed in the open air the siphon tube opens at once and the tube is always open when the animal is taken from the rocks it inhabits, and which are not long covered by the tide; a process of the mantle forming a kind of operculum to the siphon is often protruded a considerable distance from the shell. A little in front of the siphon is the female organ, and on the right side of the head the male, where the tentacle would be if there were one. The animal is attached by a horseshoe muscle running round the posterior half of the shell above the mantle and foot; the siphon is seen as the tube running in a sinuous form through the pulmonary sac; by its side runs the intestine, which continues round the posterior part of the foot, and then disappears under the liver, and the ovary, which is often the largest organ, and of a bright salmon colour; the intestine makes many convolutions in the liver; the buccal mass is red and fleshy, in which two long, thin, rather broad cartilaginous jaws are imbedded; amid these the broad radula is spread, working almost perpendicularly, with a very slight movement backwards; the œsophagus is bright orange-yellow, and terminates at the distance of about 20 mm. in a sac of the same colour; the radula curls around and projects as a closed glassy tube outside the buccal mass. The radula is about eight millimetres long (when unrolled) by three broad, and is a series of curved lines of teeth diminishing in

size from the centre to the margin; the teeth have a broad crescentic edge, which increases in width downwards and is fixed upon the membrane; the teeth gradually diminish outwardly from a central rudimentary tooth to a mere faint line of curved tubercles.

S. baconi Reeve 1856. (Not *S. luzonica* Reeve, from Philippine Islands. "Bacon's Siphonaria." Roundly elliptical, very flat, thin, usually much eroded; dull white, rarely yellow; sometimes with tiny blackish-brown spots, few or many, scattered irregularly or in patterns; interior white, the horseshoe amber coloured; radiating ribs, seventeen to forty-four. Distinguished by the particularly neat and delicate pattern of rayed sculpture. Length 30, breadth 23, height 5.5 mm. All round the coast of South Australia; common in the South-East but not elsewhere. On rocks exposed at low tide and beyond, on open ocean shores and in quiet bays. The animal is of a light saffron-yellow colour. (Type locality—Swan River, W.A.) Adcock's Handlist No. 455 gives *S. luzonica* Reeve (in error) which bears nine to thirteen ribs, stouter than ours and comes from the Philippine Islands.

S. tasmanica Tenison-Woods 1876. (Not *S. zonata* Tenison-Woods 1878.) "The Tasmanian Siphonaria." Irregularly oval, distinctly subrostrate on the siphonal side, tumidly conical, high; bluish-white concentrically and variously zoned with olive lines or bands; interior rich purple-brown, highly enamelled; spatula brownish-white extending partly down the siphonal sinus; radiating ribs forty to fifty, fine, flattened, more or less interrupted by the siphonal canal; protoconch median, brown, hooked backwards and spirally curved, its nucleus deep amber and deviated to the left, on which side alone the two distinct, slightly elate, smooth, round whorls of the protoconch are visible; shell margin dentate, rarely dotted with white. Animal, dull brown, with numerous small light spots of varying size; foot yellowish, shading to orange near the head; mantle brown, fringed at the edge with whitish and black spots; when the mantle is irritated the black spots appear to be the points where it is drawn in; head, a large and many-lobed mass, forming a cup-like expansion round the very small mouth; no eyes visible. Length 22, breadth 19, height 9 mm. McDonnell Bay also Beachport, on rocks above low water, rather common. Chiefly distinguished by the livid brown colour of the interior, and short white tessellated spots on the inner margin; depressedly convex, ribs alternately larger. (Type locality—Tasmania.)

Gadinia Grey 1824. Patelliform, obliquely conic; protoconch obtuse, subcentral; aperture orbicular, with a small groove directed from the centre to the anterior side of the right margin,

tangential to the end of the muscle-scar, which is horseshoe-shaped and broadly open in front; a small muscular scar in front of the left end of the adductor-scar. Type—*Gadinia afra* Gmelin (Africa).

G. conica Angas 1867 (= *G. angasi* Dall 1871). Pl 3 fig. 8. "The Conical Gadinia." Very variable. Convexly conical; white, outside and in; radiating ribs, about thirty-eight, strong, irregular, concentrically ridged; protoconch subcentral. Length 16 breadth 14 height 7 m.m. Ocean beaches, from Beachport to the Head of the Great Australian Bight; not common, but typical. (Type locality—Coogee Bay, N.S.W.)

G. albida Angas 1878 (*Siphonaria*). "The White Gadinia." Elongately ovate, subsymmetrical, sharply conical, rather thin; white; radiating ribs very numerous, rounded, unequal, crossed more or less with squamose ridges; protoconch subcentral, prominent, smooth, recurved; siphonal groove inconspicuous; interior white, shining, almost pearly. Length 16 breadth 12 height 7 mm. Uncommon. (Type locality—Gulf St. Vincent.)

Pugillaria Iredale 1924. Patelliform, subconvex, depressed; radiating ribs numerous; protoconch posterior, oblique, inclining backwards, pointed and slightly projecting posteriorly; right margin faintly bulged above the siphonal groove, just in front of the middle point. Type—*Siphonaria stowae* Verco 1906.

P. stowae Verco 1906 (*Siphonaria*). Pl. 3, fig 5. "Stow's Pugillaria." Small, rather solid, oval, depressed; ribs opaque white; dark brown specks, lines and blotches, chiefly intercostal, plainer on the right side; interior light-horn, a chestnut horseshoe around the posterior third, and broken blotches on each side of the siphon; radiating ribs numerous, subdistant, rather rude, as wide as the interspaces, multiplying by frequent intercalations; growth lines rough, irregular; protoconch subterminal one-eighth distant from anterior end, slightly to left of the mid-line, oblique, inclining forwards, pointed, slightly projecting anteriorly; dorsum somewhat convex; left margin straightly convex; right more rounded, bulge dat the site of the siphon; interior smooth, margin invalidly crenulate. Length 10 breadth 7 height 4.5 mm. Pondolowie Bay, Encounter Bay, Sceales Bay, Tourville Bay. Uncommon. (Type locality—Pondolowie Bay, in Spencer Gulf, on rocks above tide-mark.)

LIMNAEIDAE.

"Pond-snails." Thin, horn-coloured, mostly spiral, usually dextral, sometimes limpet-like, capable of containing the entire animal contracted; mouth simple, rounded; lip sharp; no operculum. Distribution—from Greenland to Straits of Magellan, in fresh water (sometimes brackish), of all altitudes and latitudes. Fossil—Lias. Animal with a short, broad muzzle, dilated at the end; mouth wide with a horny upper jaw; tentacles flattened or foliform, with the eyes sessile, at their inner bases; mantle-margin variously modified; respiratory orifice at the right side; foot flattened, lanceolate, or ovate; excretory orifices on the left side of the neck; no inferior pallial lobe. The fresh-water, air breathing molluscs of which this family is composed live in lakes, ponds, pools, ditches, and, though not so abundantly, in rivers; occasionally found in brackish waters; they crawl on the mud and stones at the bottom, or on water-plants, and in warm sunny weather ascend to the surface, and creep, as it were, reversed on the surface of the water, or letting themselves down occasionally by means of a glistening thread. Some feed on Confervae and other aquatic plants, while to others nothing seems to come amiss, even drowned cats, and some are cannibalistic when overcrowded. When the ponds are dried up the Limnaeids bury themselves in the mud to a depth of several inches whilst it is still soft. Ice on the pond does not stop their activity below, and they may even be frozen in solid ice, apparently without prejudice to their vitality. They are prolific, and it is estimated that with some species, an individual produces about 1,300 eggs in one season. These are deposited in cylindrical masses of clear jelly. Full-sized specimens of shells need be sought only in large ponds; it appears that the rate of development and ultimate size attained are in direct proportion to the volume of water in which the individuals have lived. A number taken from a water-meter were adult but very small. Pond-snails have been recorded from unlikely situations—in a pool, about 20 feet in diameter, cut off from streams and fed by a spring; in the isolated waters of pits, quarries, and brick-yards; in ponds which had been dry for three years at a stretch, they reappeared in the fourth year as abundant as ever when rains replenished the ponds; in a puddle, containing two or three gallons, formed by the breaking out of a small spring by the roadside; commonly found in horse-troughs, and sometimes in troughs which are nowhere near a pond or other water; a living specimen was found on the top of a church in Preston (England), probably carried there adhering to one of the sticks taken by a jackdaw

building in the tower; in an artificial pond, six feet across and a few inches deep, in California, in a district where for miles there was no natural surface water; in a dew-pond on the South Downs (Sussex) 300 feet above the marshes, with the nearest water distant half-a-mile. Some pond-snails are not altogether incapable of migration on land. Animals of various kinds, it can hardly be doubted, are actively engaged in dispersing shells. Birds have been shot on the wing with shells and ova attached, and ducks have been seen to rise from a pond with duckweed adhering to their backs, so it seems probable that young and small shells may sometimes be transported along with the water-plants.

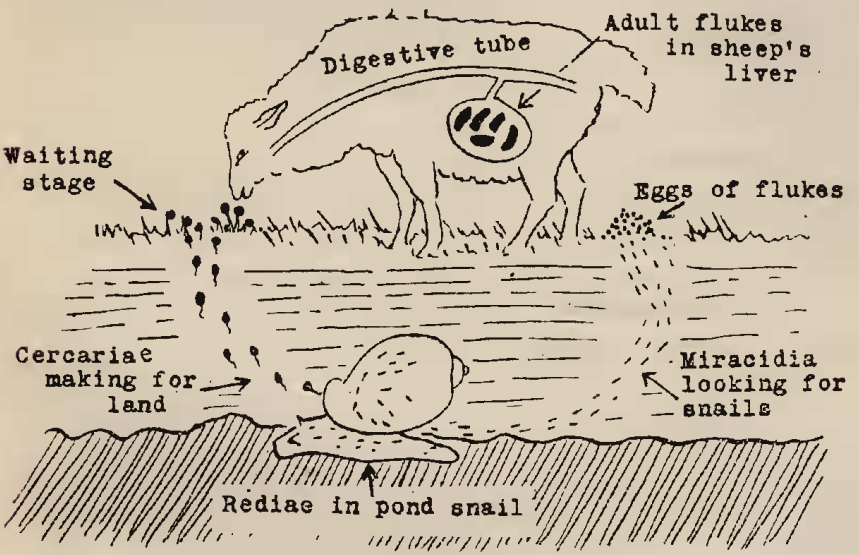

Fig. 1—The Life-cycle of the Liver-fluke. (After "Science of Life".)

Some members of this universal family are the intermediate hosts of the Liver-fluke (*Fasciola hepatica*) the cause of Rot, that scourge of the sheep-farmer. The parasite spends part of its life cycle in the body of the pond-snail. See text fig. 1. Both sexes are united in the same individual Liver-fluke which is very prolific, though incapable of self-fertilisation. It lives in the sheep's liver. The eggs leaving the liver of an infected sheep, pass out with the excrement, and are deposited on the pasture. They hatch out

into tiny, conical creatures of simple structure, without mouth or stomach, and these swim about in puddles and drinking pools. It is here that the *Miracidium* as it is called, comes in contact with a certain species of pond-snail and bores into it. If a snail is not found within eight hours, the *Miracidium* perishes. Within the body of the snail the *Miracidium* alters, becoming like an elongated hollow bag. After a fortnight's nourishment by the blood of the snail, the parasite produces a number of young and dies. The *Rediae,* as the young are called, are worm-like creatures, feeding on the snail's body, showing preference for the liver. Several generations of *Rediae* live and die within the snail, until finally a new form appears, the *Cercariae,* smaller than the *Rediae,* with big round heads and long thin tails. The *Cercariae* leave the snail in search of bigger prey. They swim up wet blades of grass, protecting themselves with a coat of slime which hardens, and enter the sheep by the mouth when the life cycle begins afresh. It is to be noted that for one parasite there is but one snail species, another will not do even if closely related. This is again referred to under *Isodorella newcombi* of this family.

Limnaea Lamarck 1799. "Pond-snail." Spiral, thin, horny, dextral; spire pointed; protoconch few-whorled, small, obtuse; mouth oval, large, rounded below, margins united by a thin callosity; peristome thin, sharp; columella with an oblique fold entering above. Type—*Helix stagnalis* Linne, (Europe).

L. subaquatilis Tate 1880. Pl. 2, fig. 2. "The Subaquatic Limnaea." Dextral, ovate, thin, shining; pale horn-coloured; smooth; axially very weakly plicate; spire one-sixth of total length, pointed; whorls four, subventricose; suture impressed; mouth large, ovate, half the length of the shell; outer lip moderately expanded; columellar fold thin; opaque white, and reflected. Height 10, diam. 5.5 mm. River Torrens (Adelaide), Torrens Reedbeds (near Henley Beach), a pond at Victor Harbor, Millicent. (Type locality—Among paludinal herbage growing on the marshy margins of the River Torrens at Adelaide).

L. lessoni Deshayes 1880. Pl. 2, fig. 3. "Lesson's Limnaea." Dextral, globose, thin; pale horn-coloured; smooth; spire one-eleventh of the total length of shell; outer lip moderately expanded; columellar fold slender. Height 25, diam. 20 mm. Morgan (River Murray), Binnum, Port Darwin, Palm Creek, Clarence River. (Type locality—New Holland).

Myxas (Leach) J. Sowerby 1822 (= *Amphipeplea* Nilsson 1823). Globular, ventricose, mostly dextral, thin, horny, translucid; spire very short, sharp, depressed; last whorl ventricose; mouth very large, rounded below; columella without any fold; outer lip sharp. Type—*Helix glutinosa* Montfort. (Ireland). Animal with the mantle-margins developed, partly covering the shell; tentacles flat, triangular.

M. papyracea Tate 1880 (*Limnaea*). Pl. 2, fig. 1. "The Paper-shell Myxas." Dextral, oblong-ovate, thin, shining; pale horn-coloured; smooth, spirally faintly wrinkled; spire about one-tenth as long as the rest of the shell; whorls half-rounded at the sutures, last whorl sub-expanded below; outer lip sinuously produced about the middle; columella without distinct fold; inner lip widely and thinly spread. Height 17, diam. 10.5 mm. Penola, Torrens Reedbeds (Near Henley Beach), Discovery Flat (Kangaroo Island). (Type locality—The bed of a dried-up marsh near Penola, S.A.). The mantle lobes entirely cover the shell; the foot is so voluminous that it cannot be wholly withdrawn into the wide-mouthed shell; the egg-mases are circular in outline, about one-fourth of an inch in diameter, depressed ,the exterior somewhat coriaceous; the egg-capsules number about forty.

Isodorella Tate 1896. "Reversed pond-snail." Spiral, sinistral, globose; last whorl much inflated, peritreme continuous, adnate to the parietal wall, and forming a false umbilicus; columella without a fold. Type—*Physa newcombi* Adams & Angas 1863. Animal having the tentacles slender (filiform-cylindrical), suddenly dilated at the base of the upper outer side, the eyes on the inner base of the tentacles; mantle not exsert, with a plain margin.

I. newcombi Adams & Angas 1863 (*Physa*) (= *Physa subinflata* Sowerby 1873) Pl. 3, fig. 4. "Newcomb's Isodorella." Sinistral, ovate-globose, thin; brownish; periostracum horny, raised into spiral fringes of hairs and imbricating folds at the suture; spiral striations, very fine; spire acute, one-fourteenth length of whole shell; outer lip expanded; no columellar fold. Height 13.5 diam. 11.5 mm. Mt. Margaret (Central Australia), Alice Springs, Eyre's Peninsula, River Para, River Angas at Strathalbyn, Penola, Kangaroo Island, Naracoorte. (Type locality—Mt. Margaret, Central Australia). *I. brazieri* Smith 1883 (*Physa*) from New South Wales, appears to differ from *I. newcombi* only in that the spire of *brazieri* is a little less prominent and the body-whorl a little less inflated. Tate (Feb.

1896) considered *brazieri* as a mere individual variation of *newcombi*. *I. brazieri* Smith is known to be the host of the Liver-fluke in New South Wales, but it is not known regarding *I. newcombi*. The Liver-fluke is referred to at some length under family *Limnaeidae*. *I. newcombi* burrows in mud on the drying up of the water of the pool, and forms a hemispheric operculum of fine silt to close the mouth; the fine nature of this material is considered due to the mud having first passed through the snail's body. *I. subinflata* Sowerby was probably figured from an elongate individual of *I. newcombi*.

I. inflata Adams & Angas 1863 (*Physa*) Pl. 2, fig. 5. "The Inflated Isodorella." Sinistral, ovate-globose, thin; olive-green; spiral striations very fine; spire one-seventeenth length of whole shell; outer lip expanded; no columellar fold. Height 13.5 diam. 12.5 mm. Wakefield River, Torrens Reedbeds. (Type locality—Wakefield River). Closely resembles *I. newcombi* except that the spire is shorter, the whorls more swollen, and the colour olive-green.

I. rubida Tate 1881 (*Aplexa*). Pl. 2, fig. 7. "The Ruddy Isodorella." Sinistral, ovate-globose, solid; dark reddish-brown, mouth violet within; margin of the outer lip and columella white tinted; spire one-seventh length of shell; outer lip expanded; no columellar fold. Height 13 diam. 10.5 m.m. Yabmana (creek) Franklin Harbour, Kangaroo Island. (Type locality—Yabmana, S.Aust.). Resembles *I. newcombi* in shape but is easily distinguished by the solidity and dark reddish-brown colour of the shell, also by the carmine colour of the animal.

Ameria H. Adams 1861 (= *Glyptophysa* Crosse). Ovate sinistral; whorls flattened, angulated or carinated at the posterior part; spire short, depressed. Type—*Physa carinata* H. Adams. Of the species described here *A. aliciae*, Reeve, has the typical angulation and carination of *Ameria*, though the spiral carinations are obsolete in some specimens. Other species mentioned have not the carination, but otherwise closely allied to the type of *Ameria* and for the present included in that genus. The spire is very variable in length.

A. tenuistriata Sowerby 1873 (*Physa*) (= *Physa texturata* Sowerby). Pl. 2, fig. 6. "The Thinly Striated Ameria." Sinistral, subfusiform, fairly solid, fine reticulate sculpture; dark olive; axial striae distinct; spiral striae indistinct; spire barely a quarter of entire height; outer lip slightly expanded; columellar fold thin. Height 15.6 diam 9 mm. Reedy Creek, Mt. McIntyre Flat; River Onkaparinga, at Grunthal and Noarlunga; Peake, Strathdownie; Reedbeds River Torrens. Not uncommon (Type

locality—River Torrens). *P. texturata* Sowerby (Type locality—South Australia) was described as having the extreme upper margin of the whorl bordered with a fine white thread-like line, with a narrow dark band beneath it. *A. tenuistriata* is distinguished by the fine textured sculpture only visible under lens.

A. pyramidata Sowerby 1873 (*Physa*). Pl. 2, fig. 8. "The Pyramidal Ameria." Sinistral, pyramidal, solid, without reticulate sculpture; light brown; smooth; spire produced, from a quarter to a third of the length of the shell; whorls seven; rather convex; mouth auriform; outer lip slightly expanded; columellar fold present. Height 25.3, diam. 11 mm. Robe; Lake George, Beachport; Lake Wangary; River Torrens; Happy Valley Reservoir. Common. Very variable in length of spire. (Type locality—Flinder's Island, Bass Straits).

A. bullata Sowerby 1874 (*Physa*). Pl. 2, fig. 9. "The Inflated Ameria." Sinistral, ovate, inflated, rather thin, without reticulate sculpture, brown, smooth; spire from a fifth to a sixth of the length of the shell; whorls five-and-a-half, whereof the three or four upper ones are very small; mouth auriform: outer lip somewhat expanded; columellar fold thin. Height 18 diam. 10 mm. Overland Corner, River Murray; Lake Alexandrina; River Onkaparinga; Point McLeay; pond, Encounter Bay. (Type locality—South Australia.)

A. pectorosa Conrad 1850 (*Physa*). Pl. 2, fig. 10. Sinistral, ovate, tumid, solid; pale olive; smooth, except for growth striae; penultimate and body whorls inflated, apical whorls small; spire very variable in length; mouth banded with chestnut brown; columellar fold duplicate, posterior fold distinct, anterior indistinct. Height 24.6, diam. 13.7 mm. Ballone River; River Murray at Tailem Bend and Mannum; Lake Alexandrina; Binnum. (Type locality—Bogan River.)

A. aliciae Reeve 1862 (*Physa*). Pl. 2, fig. 11. Sinistral subovate, thin; white, periostracum yellow; whorls angulate spirally weakly carinate, carinations sometimes obsolete; spire from one-fifth to one-sixth of the length of shell; outer lip slightly expanded; no distinct columellar fold. Height 15, diam. 8.3 mm. Tailem Bend, River Murray; Lake Alexandrina; Gawler River; River Onkaparinga. (Type locality—Murray and Gawler Rivers, South Australia.)

PLANORBIDAE.

"Flat-coil Pond Snails." Discoidal, sinistral, usually consisting of many slowly increasing cylindrical whorls. Distribution —World-wide. Fossil—Lias. Animal having the inferior pallial lobe very prominent and transformed into a branchia; tentacles very long and slender; foot short and round, attached to the upper part of the body by a stalk. The animal seems too small for the shell, and when crawling, leaves part of the shell empty, putting one in mind of loose and ill-fitting clothes. Some species emit a purple-coloured fluid when irritated. Some of the smaller species inhabitating marshes which are dried up in summer, close the mouth of the shell with an epiphragm, or filmy covering, like land-snails, and await the rains. Herbivorous, frequenting stagnant or slowly-running water with an abundance of plants in it. They have been found at altitudes of 12,000 feet. Sexes united in the same individual. Eggs enclosed in a globular bag, fixed to stones and submerged water-plants; not many days are required for the eggs to hatch. In the latter part of the eighteenth century there was considerable discussion as to whether the shells were right or left-handed; it was settled by O. F. Muller 1774.

Planorbis Mueller 1774. Planorbis means flat-coil. Sinistral, more or less discoidal; spire flat, depressed on one or both sides; whorls slowly increasing, all of them visible from both sides; mouth small; peristome sharp, continuous. Type—*Helix cornea* Linne (England, Ireland, Europe, Siberia). Animal elongated, slender; mantle with a thickened margin; foot short, truncated in front, rounded behind; tentacles long, filiform.

P. isingi sp. nov. (not *P. obtusus* Deshayes from North Australia: not *P. fragilis* Brazier from Queensland). Pl. 3, fig. 9, 10. "Ising's Planorbis." Planorbid, depressed, thin; yellow, mouth whitish; axial growth lines, regular; whorls four, obtusely keeled; columella convex, following the curvature of the penultimate whorl; umbilicus wide, very shallow. Type—Height 2, diam. major 7.3, minor 6 mm. Point McLeay, Lake Alexandrina. (Reg. No. D10603, S. Aust. Mus.) Distribution—Reed-beds, River Torrens; Murray Bridge, River Murray; Meningie, Lake Albert; Riverton; Valley Lake, Mount Gambier. Rather variable. Most nearly related to the Tasmanian *P. atkinsoni* Johnston, but flatter, smaller, whorls less acutely angled, mouth wider but not so high. Named after Mr. E. H. Ising, chairman of the Field Naturalist Section of the Royal Society of South Australia (Inc.) and previously secretary for several years.

Segmentina Fleming 1830. Flattened; whorls usually laterally compressed, with angulated periphery, the last whorl embracing, internally contracted by periodic lamellae, usually three in number, and occuring three times in each volution. Type—*Planorbis lacustris* Forbes & Hanley, = *P. lineatus* Walker. (Europe). In the type, the internal plates, which are observable outside the last whorl of the shell, form half-closed chambers, and the animal retreats into the front one for safety; these plates appear to answer the same purpose as the teeth or folds which barricade the apertures of many of the small land-snails. The peculiarity of this structure induced one of its earliest discoverers, Lightfoot, to call the shell a *Nautilius*.

S. victoriae Smith 1881. "The Victorian Segmentina." Planorbid, dextral, glossy, chestnut; rather acutely keeled a little below the middle of the last whorl, obliquely convex above the keel, and not much flattened at the base; spire small, sunken in the middle; whorls four, convex, separated by a deep suture, last whorl larger; mouth horizontal, much encroached upon by the whorl, flat at the base, rather acute on the right; umbilicus deepish, occupying one-third the diameter of the base. Height 1.3, diam. 4 mm. (Type locality—Victoria). Also South Australia. In colour and general aspect closely resembles *S. australiensis* Smith (Penrith, N.S.W.) but is less flattened beneath; last whorl proportionately larger, and the sunken spire smaller; umbilicus narrower; no internal lamellae. Smith, when describing *S. victoriae* referred to the apparent inconsistence of placing a shell in the genus *Segmentina* lacking the essential character of internal lamellae, but its tout-ensemble being so Segmentinoid it is probably an abnormal form of that group.

ANCYLIDAE.

"Fresh-water Limpets." Non-spiral, conical, limpet-like. Distribution—Australia, Tasmania, New Zealand, Europe, North and South America. Fossil—Eocene. Animal not spirally coiled; tentacles short and compressed; inferior pallial lobe transformed into a branchia. Air breathers, inhabit both rapid and still waters, attached to stones and plants; some species appear to be amphibious, being found on rocks at the side of water-falls, having no other moisture than the spray which occasionally falls; when crawling only the tips of the tentacles and possible the front edge of the mantle are usually visible. Food consists of freshwater *Algae* or *Confervae*, as well as decayed vegetable matter. They have often been observed upon the wing-cases of flying water-beetles, and this is one means of distribution explained. One was also detected adhering to the leg of a

frog thirty yards from the nearest water. Tasmania possesses the largest known fresh-water limpet, *Ancylastrum irvinae* Petterd, measuring half an inch, whose peculiar features in addition to size, are the excessive deviation of the apex, the peculiar spiral protoconch, radiate sculpture and the subangulately rounded aperture.

Ancylus Geoffroy 1767 (Ancylus = a small round shield). "River Limpet." Conical, limpet-shaped, dextral or sinistral, thin; protoconch posterior, turned to one side; aperture with quite simple margins; interior with a subspiral muscle scar. Type —*A. fluviatilis* Muller (Europe), a dextral shell, each individual laying about 80 eggs in a season, which are enclosed in from seven to ten capsules, arriving at maturity in from twenty-four to twenty-seven days.

A. australicus Tate 1880. Pl. 3, fig. 11. "The Southern Ancylus." Limpet-shaped, lengthened, thin, delicate; pale-horn, older parts having a reddish to blackish-brown periostracum; strong concentric folds anteriorly; protoconch blunt, at about two-fifths from the posterior end, inclining backwards, and directed to the right; slightly concave behind the protoconch; peritreme, oval, narrowed posteriorly. Height 1.5, length 4, breadth 2.5 mm. (Type locality—North Australia) Lyndoch Valley; Reedbeds, River Torrens on under-side of floating leaves of *Triglochin procera*, on the under side of stones and on the submerged leaves of aquatic plants, abundant; Brownhill Creek; Waterful Gully; Cooper Creek at Innamincka. Animal having the foot translucent, white, obtusely rounded behind; tentacles translucent, white, triangular, and subcompressed at the base, cylindrical in the upper part, with a blunt tip; eyes black, placed in front of and slightly interior to the bases of the tentacles; muzzle emarginate when extended; only the tips of tentacles visible from beneath the shell when the animal is gliding.

Gundlachia Pfeiffer 1849. "River Limpet." Limpet-shaped, thin, non-spiral, obliquely conical; protoconch inclined backwards, basal side two-thirds closed with a flat horizontal lamina; aperture anterior, horizontal, semicircular. Young shells without a septum. Type—*G. ancyliformis* Pfeiffer.

G. petterdi Johnston 1878 (= *A. woodsi* Johnston 1888: = *G. beddomei* Petterd 1887). Pl. 3, fig. 12. "Petterd's Gundlachia." Minute, thin, diaphanous, spirally oblong in two distinct tiers; pale horn coloured; concentric striae crossed by radiate lirae; protoconch oblique, inclined posteriorly; apical tier more encrusted with confervoid matter, and appearing partially and obliquely exserted upon the basal tier; the projecting portion of apical tier as well as one-third of the basal tier closed by a

flat horizontal plate all in the plane of original aperture of apical tier; outer aperture broadly ovate; lip of basal tier continuous, although modified at junction with apical tier; inner aperture semi-circular; inner lip with slightly raised rim continuous, simple. In young the shell is simple and resembles an *Ancylus*. Length 6.5, breadth 3mm. Mt. Lofty (Tate MS.). (Type locality—On leaves in a pool, First Basin, Launceston, Tas.) Animal pale yellowish, with broad roundish muzzle, two short tapering tentacles; eyes sessile behind the tentaculae; mouth with dark serrated horny jaws.

PUPILLIDAE.

"Chrysalis-snails." Cylindrical, pupaeform, minute, umbilicated or rimate, multispiral; protoconch obtuse, sometimes reticulately pitted; mouth with 0-5 small teeth obstructing the aperture; no basal lamella; peristome usually reflected or expanded; outer lip with a tuberculiform callus above. Distribution —World-wide. Fossil—Carboniferous. Animal witha foot half as long as the shell, skin nearly smooth, inferior tentacles short but distinct. Small and gregarious; live in moss and rock crevices, on exposed hill sides under stones or at the roots of grass; vegetable feeders, living on small plants, and decaying leaves. Sexes united in the one individual. Some species ovoviviparous. The curious processes, called "teeth," when present, fence in and contract the mouth of the shell, and may possibly serve a practical purpose in keeping out insect enemies which frequent the same situations.

Pupilla Leach 1831 (= *Pupa* of most authors). Horny, dextral or sinistral, cylindrical, with rounded, obtuse ends; striae faint or weak; protoconch minute, obtuse, pitted-reticulate; adult whorls 5-9, convex, short, slowly increasing; sutures slightly oblique; mouth rounded, with or without teeth, sometimes with an angular tubercle; peristome narrowly reflected; umbilicus a mere slit. Type—*Pupa muscorum* Linne (North America). Animal with the foot about half as long as the shell, skin nearly smooth; inferior tentacles short but distinct. Some species at least are ovoviviparous. Ground snails, living under wood and stones and among leaves in moderately humid situations. Albino shells are not uncommon.

Pupilla australis Adams & Angas 1863 (*Vertigo*) (= *Pupa lincolnensis* Cox: = *Pupa nelsoni* Cox: = *Pupa tasmanica* Johnston). Pl. 3, fig. 14.

"The Southern Pupilla." Sinistral, cylindrical; pale-brown; striae oblique, strong; protoconch obtuse, irregularly, densely, shallowly pitted; whorls seven, convex; mouth semi-ovate; peritreme thickened, broadly dilated, with a single parietal and a single columellar fold and a small columellar tubercle; um-

bilicus a chink. Height 4, diam. 1.8 mm. Rapid Bay, Marino, Halletts Cove, Edithburgh, Port Lincoln; under stones. Not common. Along the coast from Sydney and South Australia to the islands off Western Australia. (Type locality—Rapid Bay, S.A., in crevices of rocks.) Type locality, *P. lincolnensis* Cox—Port Lincoln; *P. tasmanica* Johnston—Swansea (Tasmania) sand dunes; *P. nelsoni* Cox, Nelson Bay, New South Wales. Very variable.

Pupoides Pfeiffer 1854. Small (about 3-6 mm), long-ovate, dextral or sinistral, turreted or rarely cylindrical; protoconch obtuse; whorls (generally 5-6), rather long; mouth ovate, toothless except for a small, tuberculiform, angular lamella close to the insertion of the outer lip, or united with it, but rarely wanting; peristome expanded, reflected and usually thickened within; umbilicus a mere slit. Type—*Bulimus nitidulus* Pfeiffer. Distribution all continents except Europe. *Pupoides* is mainly a tropical and subtropical genus, but occurs also in arid, or relatively dry stations in humid areas. Found under stones or at the roots of grass, and sometimes after rains on trees a few feet from the ground. The living shells are often coated with dirt adhering by the slime of the animal. *Pupoides* differs from *Pupilla* by the tapering spire, the longer, more loosely coiled whorls, longer mouth and the obliquity of the parietal margin of the latter; there is never a crest or furrow behind the lip.

P. adelaidae Adams & Angas 1863 (*Buliminus*) (= *Pupa ramsayi* Cox 1864). Pl. 3, fig. 15. "The Adelaide Pupoides." Solid, dextral, pupiform, turreted, dilated in the middle, rather opaque, cream-buff with whitish streaks, browner towards the protoconch, whiter on the last few whorls; striae distinct, irregular; whorls six, convex; the penultimate whorl as wide as the last, and above that it tapers rapidly to the small somewhat obtuse, glossy protoconch; mouth roundly-ovate, peristome interrupted, white, narrowly reflected, internally thickened, outer lip with a small white, angular tubercle above. Height 6.4., diam. 3 mm. Flinders Range, Rapid Bay, Wallaroo, Point Lowly, Port Lincoln in rocky places. Larger and more cretaceous than other Australian species, and has the appearance of a desert snail. (Type locality—"South Australia, rocky places." Angas).

P. myoporinae Tate 1880 (*Bulimus*) new name for *Bulimus sinistrorsus* Tate 1879, not of Deshayes). "The *Pupoides* found living under the shelter of *Myoporum parvifolium*." Sinistral, umbilicated, oblong-turreted, very thin, translucent; yellowish-horn; spiral striae, regular, very fine; spire elongated, gradually tapering, rather acute; whorls five, moderately convex, last whorl equalling one-third length of shell; mouth somewhat ovate peristome white, expanded, especially the columellar margin; outer lip with a white tooth-like callosity in the angle. Height

4.5, diam. 1.5 mm. (Type locality—Under small bushes on the sandy margin of the salt swamp at Peelunibie, head of the Great Australian Bight, 50 examples observed.

P. ischnus Tate 1894 (*Pupa*). Sinistral, pyramidally oval, thin, translucent, shining; yellowish-brown; striae, fine, oblique; protoconch obtuse; whorls five-and-a-half, moderately convex; suture impressed; mouth oval, truncated above, peristome white, broadly reflected, especially over the columella, which does not conceal a narrow umbilical fisure; lips callously united and there is a prominent tubercle at the insertion of the outer lip. Height 4.25, diam. 1.25. (Type locality—Alice Springs and Palm Creek). Agrees with *P. myoporinae* in its sinistral spire and apertural characters, but differs in its narrow elongate shape and flatter whorls.

SUCCINEIDAE.

"Amber-snails." Dextral, oblique, paucispiral, very thin, transparent, body-whorl large, mouth large, no operculum. Distribution—World-wide, in damp places, near the margins of lakes, ponds, and ditches, or in dry situations where no water ever lodged. Fossil—Eocene. Animal of a gelatinous consistency, with foot large and oblong; tentacles four, the lower pair very short (in some species absent); jaw with a median quadrangular accessory piece, projecting upwards. The amber-snails are usually a little too big for their shells, and are vegetarians. Shells without columellar fold.

Succinea Draparnaud 1801. *Succinea* signifies amber-colour. Oval, very fragile, transparent; spire short; whorls few, very rapidly enlarging; mouth oval outer lip thin, not reflected, united below by a broad curve with the thin, smooth columella. Type—*Succinea putris* Linne (England) which shell is sometimes found with the tentacles abnormally distended by the presence of a fluke (*Distoma macrostomum*) which is destructive to birds partial to amber-snails, like the blackbird, thrush and wagtail. The completion of the life cycle of the parasite must take place in the body of a vertebrate, so when the Amber-snail is eaten by the bird, the *Distoma* is in a position to fulfil its destiny. (See also under *Limnaeidae*).

S. australis Ferussac 1821 (= *S. legrandi* Cox: = *S. strigata* Pfeiffer). Pl. 3, fig. 16. "The Southern Amber-snail." Ovately conical, thin, transparent; pale-horn colour, sometimes with darker streaks; striae rugose; whorls three, convex, last forming two-thirds of the length; mouth acutely oval, incumbent; peristome simple, straight; columella subcallous, somewhat slightly receding. Height 12, diam. 7 mm. Rather common. (Type locality—Kangaroo Island and the Isles of St. Peter and St. Francis, S.A.)

HELICIDAE.

"Snails." Spiral, usually depressed, moderately thick; mouth edentulous or contracted by teeth; lip usually reflected; no operculum. Distribution—Universal. Fossil—Cretaceous. Animal having a short, well-developed retractile head, with four cylindrical retractile tentacles, the upper pair longest, and bearing eye-specks at their summits, the lower occasionally wanting; mouth with an arched and ribbed jaw; body spiral, distinct from the foot; respiratory orifice near the base of the right ocular tentacle, small and valve-like; mouth armed with a horny, dentated, crescent-shaped upper mandible. Snails have their periodical seasons of repose, apparently when there is a deficiency of food, or during climatic extremes; in cold climates, they hibernate, burying themselves in the ground, or nestling in rock crevices, under the bark of trees or in the hollow of umbelliferous plants; at this time they exude a quantity of slime, which, when hardened by exposure, forms a slight membrane, called the epiphragm, entirely closing the mouth of the shell; at a little distance within, a second membrane is stretched, then a third and sometimes a fourth, always thinner than the first one. In our warmer climate snails do not hibernate, but aestivate, or summer-sleep, and await the rains when they emerge to find succulent food; the epiphragm during aestivation is thinner than in hibernation, but serves to keep the dry air out and the moisture inside. The shell is sufficiently roomy to accommodate the entire animal and varies considerably in size and shape; it may be disk-shaped, nearly spherical, or conical according to the species. The sexes are united in the same individual. In many species of this family, including the imported, common garden-snail (*H. aspersa*) there is the development of what has been termed the "love dart." The instrument consists of a delicate shaft of carbonate of lime, finely pointed, and contained in a pocket of the female organ, whence it is discharged just prior to the union of two individuals, and embedded in the flesh of its mate. It is only found in mature snails, and its use apparently is to excite the sexual instinct. "Love darts" have been found piercing leaves, showing that the aim is not always true. The eggs are roundish, enclosed in tough "shells" which are laid in little heaps, often in burrows excavated by the foot of the snail. Three typical genera of South Australian *Helicidae* are dealt with here. They are sometimes all grouped under *Thersites* Pfeiffer, but this becomes thereby somewhat unwieldy, and further many of our species have a facies not matched elsewhere. We prefer to follow Pilsbury (Tyron), except as regards a section of desert snails peculiar to South Australia and Western Australia for which we propose a new genus.

Badistes Gould 1862. Globose, rather thin, sometimes with a peripheral keel; surface densely microscopically granulated all over; spire elevated, somewhat dome-shaped; peristome a little thickened and very narrowly expanded, suddenly dilated at the columellar insertion, closing or almost closing the narrow umbilicus. Type—*Helix gulosa* Gould 1846 (Illawarra, N.S.W.) Animal with a slight groove on each side, running from the lips upward and backward to the mantle; back with a median furrow banded by two rugae or sets of rugae, on each side of which there are about six ranks of long narrow tubercles; rest of body partially covered with irregular polygonal tubercles which are usually subdivided into minor tubercles; jaw arched, crossed asymmetrically by nine stout, flat-topped unequal ribs, denticulating both margins. Distribution—Mainly New South Wales and Victoria, but also South Australia. The species are highly polymorphic, and have evidently been moulded by external conditions into a great number of local forms. The distinguishing features from the next genus, *Notobadistes* gen. nov. are in brief: Carinated or subcarinated at the periphery, unicoloured or with a dark band at suture and umbilicus. The representative genus of tropical Australia is *Sphaerospira* Morch 1867, which is larger and more solid, yellowish, with brown spiral lines and bands of uniform chocolate brown; surface smooth, peristome broadly expanded.

B. bednalli Brazier 1871 (*Helix*). "Bednall's Badistes." Umbilicated, rather conoidly globose, dextral, very thin, fragile, obliquely rugose at the upper part, granulated under the lens, subdiaphanous; light horny green, with a fine reddish ring encircling the suture, another broad one encircling the umbilicus; spire conoid, somewhat obtuse; whorls about five, moderately convex, the last very much inflated, rounded; base convex, smoother than the upper surface; mouth obliquely lunar, large; peristome thin, pinkish; outer lip expanded; columellar margin reflected and partly covering the umbilicus. Height 10, diam. 16 mm. (Type locality—Near Adelaide).

B. patruelis Adams & Angas 1863 (*Helix*). "The Cousinly Badistes." Umbilicated, orbicularly-depressed, dextral, rather coarsely rugosely ribbed, especially at the suture, rather thin, moderately shining; reddish-chestnut with a pale spiral band under the suture; spire widely and obtusely conical; whorls five, convex, last whorl sometimes indistinctly angulated, not descending in front; base smoother and more glossy than above, with a wide yellowish patch surrounding the dark circumference of the umbilicus, which is moderate and deep; mouth diagonal, lunately-ovate; peristome simple, thin, straight, the dark colu-

mellar margin dilated above and reflexed, to cover half of the umbilicus. Height 12.5, diam 25 mm. (Type locality—Port Lincoln, under dead logs.) Flinders Island. Very variable, ground colour ranges from pale-reddish-horny to very dark reddish-chestnut.

B. evandaleana Pfeiffer 1863 (*Helix*). "The Evandale Badistes." Umbilicated, depressed, dextral, rather thin, rugosely striated, and under the lens granulated and furnished with short hairs; dirty-yellowish and blackish brown; spire slightly elevated, obtuse, suture rather deep, whorls four, convex, last whorl more or less obtusely carinated; base convex, the striae and granulations gradually becoming fainter; umbilicus moderate, deep; mouth lunately-ovate; peristome simple, thin; more or less angular externally, at the columella triangularly dilated above. Height 7.5, diam. 13.7 mm. (Type locality—Evandale, S.A.) North Rhine and Barrier Ranges. The rugose striation, granulation, and pilosity (the last often obsolete) are characteristic.

B. tomsetti Tate 1887 (*Helix*). "Tomsett's Badistes." Conoidly depressed, dextral, rather thin, widely and deeply umbilicated; colour of living shell unknown; striae coarse, irregular, oblique; distantly granulated; spire slightly elevated, widely conical, obtuse; whorls five, flatly convex, narrowly concavely depressed near the anterior suture, and margined at the suture; last whorl rounded, rather depressed above, and bluntly angled at the periphery; posterior to angulation at the periphery the surface is slightly depressed, thence convex to the suture; base rather abruptly convex; mouth not descending in front, oblique to the vertical axis, rotundately lunate; peristome simple, thin, disunited; columella very slightly reflected over the umbilicus. Height 7, diam. 14.5 mm. (Type locality—Cape Borda). Flatter and with a larger umbilicus than *B. evandaleana.*

B. lincolnensis Pfeiffer 1863 (*Helix*). "The Port Lincoln Badistes." Umbilicated, somewhat conoidly depressed, dextral, rather thin, moderately glossy, pellucid; uniform rich deep-chestnut, suture pale; striae close, coarse, irregularly rugose; finely granulated; spire slightly elevated, widely conical, obtuse; whorls five, rather flattened, last rounded, rather depressed above, and sometimes indistinctly angular at the periphery, descending in front; base less strongly striated than above, smoother and more glossy, umbilicus small; mouth lunately ovate; peristome simple, thin, straight, margins moderately approximating, columellar margin rather widely expanded above, and reflected over half of the umbilicus. Height 8.75, diam. 20 mm. (Type locality —Port Lincoln).

B. luteofuscus Cox 1868 (*Helix*). "The Dark Yellow Badistes." Openly umibilcated, depressed, dextral, thin; yellowish-brown or dark chestnut; striae oblique, rugose; obsoletely granulated; spire rather prominent; whorls four-and-a-half, regularly increasingy, last whorl depressed throughout, on which the elevation of the spire depends, periphery blunt, slightly angled, base convex; mouth diagonal lunately rounded; peristome simple, lip thin, margins approaching, columellar margin but little everted, the opposite margin inserted beneath the angulation of the second whorl. Height 8, diam. 16 mm. (Type locality—Flinders Range).

Notobadistes gen. nov. "The Southern Badistes." Globose, rounded (not carinated) at the periphery; body-whorl with two or three colour bands above, with or without an umbilical dark patch; rather rudely, strongly, axially striate; last whorl globose, deeply descending in front; columella expanded, reflexed, nearly covering the narrow umbilicus. Type—*Helix bitaeniata* Cox 1868 (Port Augusta). The genus is characteristic of the *Helicidae* fauna of South Australia, and is confined to the southern areas of the Continent. This may be regarded as a subgenus but, to avoid a trinomial, we prefer to treat is as a full genus.

N. bitaeniatus Cox 1868 (*Helix*) (= *Helix flindersi* Adams & Angas 1863). Pl. 3, fig. 19. "The Two-banded Notobadistes." Globose, rather thin, dextral, narrowly umbilicated; straw-coloured, or tinged with green or brown, with two purple-brown bands, one at the suture, the other and wider one above the periphery; surface rather strongly striated, especially above; spire obtusely conoidal; whorls five, convex, the apical whorl shining, smooth; last whorl globose, rather deeply descending in front; mouth rounded-lunar, oblique, white within, showing the brown band; peristome blunt, not expanded, white; columella expanded, reflexed nearly over the narrow umbilicus. Height 18, diam. 20 mm. (Type locality—Port Augusta): Tillowie, near the western slopes of Flinder's Range. The most globose of this genus of two-or-three banded forms, and distinguished by its narrow, half-covered, but deep umbilicus, and strong striation.

N. loriolianus Crosse 1863 (*Helix*). Globose-depressed conoidal, dextral ,almost or quite imperforate, rather thin but strong; yellowish, with two brown bands, one at suture the other above the periphery, and a small brown umbilical patch; surface not granulate, lightly obliquely striate; spire bluntly conoidal; whorls five, scarcely convex, separated by superficial sutures; last whorl descending in front; mouth oblique, white and bifasciate within; peristome gradually but only slightly ex-

panded, columellar triangularly reflexed over the umbilicus, rose-tinted; terminations of peristome approaching slightly. Height 18, diam. 23.5 mm. (Type locality—South Australia). Less globose than *N. bitaeniata*, and not nearly so deeply cut by the oblique striae.

N. broughami Angas 1875 (*Helix*). "Brougham's Notobadistes." Narrowly umbilicated, conically globose, dextral, rather thin; very pale brown above, white below, with three narrow reddish-brown bands, one at the suture, one above and one below the periphery of the last whorl; obliquely striated and obscurely minutely granulated; spire obtusely and depressedly conical; whorls five-and-a-half, slightly convex, the last rounded, descending in front; mouth oblique, circularly lunate; peristome slightly expanded and reflexed, the margins approximating, columellar margin almost straight, dilated above, and nearly covering the umbilicus. Height 21, diam 25 mm. (Type locality—Port Lincoln). Allied to *N. cassandra*, but more elevated, the columellar straightened, dilated and reflexed, nearly covering the umbilicus.

N. rufofasciatus Brazier 1875 (*Helix* [*Hadra*]). "The "Rufus-banded Notobadistes." Moderately umbilicated, globosely depressed, dextral thin; pale brown, with dark chestnut spiral bands; minutely rugosely granulated, whorls five, slightly convex, regularly increasing, the last large and inflated in front, roundly convex, below the periphery the chestnut band becomes broader and runs spirally into the mouth; base white with chestnut brown around the umbilicus; mouth roundly lunate, slightly angular, peristome thin, acute, margins rather distant, the columellar margin dilated partly over the umbilicus, interior of mouth white or pink, the brown bands are seen through the shell. Height 14, diam. 26 mm. (Type locality—Yardea, 360 miles north of Adelaide). Approaches *N. cassandra* Pfeiffer, but differs in having dark chestnut bands above and below with a large broad white band on the base, and chestnut brown round the umbilicus.

N. subloriolianus Pilsbury 1890 (*Helix*). Depressed narrowly umbilicated, dextral, rather thin; light yellowish with a chestnut band at the suture, another just above the periphery, interior of umbilicus also chestnut coloured; surface striatulate, not granulate; spire more conoidal than *N. cassandra*; whorls five, moderately convex, the last rounded at the periphery; mouth oblique, rounded lunar, flesh-coloured within, showing the bands; peristome simple, white, the columellar triangular dilation flesh-coloured, partially covering the umbilicus. Height 14, diam. 23.5 mm. (Type locality—Flinder's Range.)

N. cassandra Pfeiffer 1863 (*Helix*). (The gift of prophecy was conferred by Apollo on Cassandra, with the reservation that no one should believe her.) Depressed, moderately umbilicated, thin; nearly white beneath, pale brownish-yellow above, with a pale brown band at suture and another above the periphery; surface delicately striatulate and densely microscopically granulate all over, save the polished protoconch; spire low, broadly convex; whorls five, convex; suture at first impressed, then becoming shallower; last whorl depressed, rounded at periphery, slightly descending in front; mouth round-lunar, white within; peristome simple, columella suddenly expanded, half covering the umbilicus. Height 13, diam. 23 mm. (Type locality —Lower Murray River, S.A., in bushy patches amongst sandstone cliffs. The low spire, delicate whitish colour, with pale bands, and densely granulate surface distinguish this form.

N. fodinalis Tate 1892 (*Helix*). Pl. 3, fig. 17. Globosely conic, moderately umbilicated, dextral, rather thin, somewhat glossy; pale-brown above, paler beneath, sometimes with a narrow reddish-brown infuscation in front of the suture; surface coarsely and closely wrinkled axially, somewhat closely and finely incised—striate spirally; whorls four and a half, regularly convex; first almost smooth but minutely granulated and obsoletely wrinkled; granulations later disappear, and wrinkles increase; last whorl somewhat inflated, slightly descending in front; suture linear; base convex; umbilicus moderately wide with precipitous sides, and towards the inner lip subangulated; mouth oblique, subcircular; peristome subacute, slightly reflected; columella-margin dilated above and slightly extending over the umbilicus. Height 15, diam. 18 mm. (Type locality—Wankaringa, S.A., beneath blocks of stones on the outcrop of the auriferous reef: alive in considerable numbers.) Between Victoria Spring and Fraser Range, one dead specimen. Differs from *N. nullaborica* in the absence of an impressed suture, finer and closer spiral striae, larger umbilicus as well as by colour and thinness of shell. Animal with foot of a chestnut colour with grey rugosities, broad and short behind; eye-pedicels blackish; tentacles chestnut; collar milk-white.

N. nullaborica Tate 1878 (*Helix*). (The specific name is from that of the treeless portion of the Bunda Plateau known as the Nullabor Plain.) Globosely conic, narrowly umbilicated, very thick, dextral; whitish; axially coarsely and closely wrinkled, interrupted by equidistant incised lines; whorls four and a half, retund, slightly flattened at the suture, which is impressed; last whorl somewhat inflated, descending but little in front, base

convex; mouth oblique, subcircular, peristome subacute, slightly reflected, margins joined by a callus; columella-margin thickly dilated above and nearly covering the umbilicus. Height 18, diam. 18 mm. (Type locality—Bunda Plateau, extending to the scrubby sand hills on its east, and to the Roe Plains at foot of the Hampton Range, in Western Australia). Somewhat resembles *N. angasiana*, but *nullaborica* differs in its more globose form, minute, umbilicus wrinkled surface, and axially impressed lines, and in the callus covering the columella.

N. angasiana Pfeiffer 1862 (*Helix*). "Angas' Notobadistes." Depressed-globose, deeply umbilicated, solid; two chestnut bands, one subsutural, the other above the periphery; growth striae distinct, oblique, also peculiar numerous microscopic spiral scratches; spire conoidal; protoconch flattened; whorls five, convex, the last somewhat descending in front, rounded at periphery; sutures well impressed; mouth not much oblique, circular; lip well expanded all around, terminations approaching, connected by a parietal callus; umbilicus deep, rather cylindrical, its sides nearly perpendicular. Height 19, diam. 22 mm. (Type locality—Near Lake Torrens, S.A.).

Glyptorhagada Pilsbry 1890. Helicoid, keeled at the periphery, rudely sculptured with oblique fold-like axial wrinkles; outer lip hardly expanded; texture calcareous. Type—*Helix silveri* Angas 1868, from the Eastern Plains of S.A. This is a South Australian genus, closely related to the two last-mentioned genera. The rudely sculptured earthy-shell is the outcome of the arid conditions prevailing in the interior of South Australia; desert snails in general appear to have undergone a similar modification. The species were formerly grouped in *Rhagada* but their affinities are evidently with *Badistes*.

G. silveri Angas 1868 (*Helix*). Pl. 3, fig. 18. "Silver's Glytorhagada." Globose-conic, umbilicated, thin, cretaceous, horn coloured, narrowly, obscurely three banded with brown, corrugated by strong, oblique, flexuous folds; spire conoid; protoconch obtuse; whorls six, a little convex, the last descending in front; periphery slightly keeled; base convex; suture distinct; mouth oblique, sub-oval, margins converging, joined by a thin callus; outer lip thin, acute, a little expanded; columellar margin expanded above, reflxed, half covering the umbilicus. Height 16 diam. 22 mm. (Type locality—The Eastern Plains, S.A.

G. kooringensis Angas 1877. "The Kooringa Glyptorhagada." Somewhat globosely lenticular, umbilicated, rather thin; cretaceous, white; strongly obliquely flexuously corrugated, corrugations more or less elevated and irreglar, the interstices crossed with short, impressed, interrupted, spiral lines, especially

on the basal portion of the last whorl; spire flatly conoidal; protoconch obtuse; whorls five, slightly convex, the last very strongly flatly carinated, not descending in front; base tumid around the umbilicus; sutures impressed; mouth oblique, subquadrate; outer lip simple; columella arcuate, slightly thickened and partly expanded over the umbilicus. Height 12.5, diam. 25 mm. (Type locality—30 miles north-east of the Burra Mines, S.A.). Similar to *G. silveri*, but corrugations less angular, umbilicus larger, shell flattened, and the last whorl very prominently keeled.

G. bordaensis Angas 1880 (*Helix*). "The Cape Borda Glyptorhagada." Lenticular, widely and deeply umbilicated, moderately thin; cretaceous, white; very strongly and irregularly obliquely flexuusly, corrugated, the corrugations becoming larger and more elevated toward the middle of the whorls; spire depressed; protoconch obtuse; whorls five, nearly flat, the last depressed and strongly keeled above the periphery, not descending in front, slightly keeled around the umbilicus; mouth oblique, semi-lunar; outer lip simple; columella very slightly expanded; margin united by a thin calus. Height 6.5, diam. 16 mm. (Type locality—Cape Borda, S.A.) Sculpture somewhat similar to *G. silveri* and *G. kooringensis*, but differs in having the raised corrugations more numerous and elevated, displaying at the sutures and on the keel an elegant frilled appearance; it is also smaller, flatter, has a wider perspective umbilicus, and the corrugated ridges show here and there a tendency to bifurcate.

G. howardi Angas (*Helix*). "Howard's Glyptorhagada." Moderately umbilicated, rather solid; yellowish-horny, with two indistinct chestnut bands; obliquely irregularly striate, and slightly, very minutely granular; whorls four and a half, slightly convex, last a little descending in front; base more convex, without bands; periphery acutely carinated; peristome white, chestnut at the junction with the body, slightly expanded. Height 10, diam. 22 mm. (Type locality—450 miles north of Adelaide).

RHYTIDIDAE.

Heliciform or auriform, generally umbilicated, with depressed or plane spire, and simple peristome. Distribution—Australia, Tasmania, New Zealand, New Guinea, New Caledonia, Polynesia, South Africa. Animal with the mantle not, or but little reflected over the shell, without a caudal pore; no jaw; mostly oviparous, but some species are known to be ovoviviparous. Carnivorus. Differs from the true Helices by the absence of a jaw.

Rhytida Albers 1860. Convexly depressed, umbilicated, thin, but not devoid of calcareous matter; striated or rugose; spire not much raised; whorls four to five, slightly convex; umbilicus wide, funnel-shaped; peristome simple sharp. Type—*Helix greenwoodi* Gray 1850 (New Zealand). Animal having neck, tail, and sides of body irregularly granular, tail flattened and pointed, foot somewhat narrow; mantle with three lobes; buccal mass very large and muscular.

R. gawleri Brazier 1873 (*Helix*). Pl. 3, fig. 20. "Gawler's Rhytida." Convexly depressed, umbilicated, thin, shining; horny-brown, with dark-reddish oblique streaks here and there; very closely rugosely wrinkled with obilque striae to the periphery, interstices smooth; spire small; whorls four and a half, moderately convex, the last large, inflated in front, depressed above; base convex, yellowish, glossy, sculptured with striae giving it a wrinkled appearance; mouth oblique, ovately lunate, interior pinkish; peristome simple, thin, margins nearly approximating, the outer arch, columella thin and reflexed; umbilicus large and deep, rounded at the edge, with the striae more distinct and running into the interior. Height 12, diam. 16 mm. (Type locality—Mount Lofty Ranges).

ADDITIONS TO OUR LIBRARY.

1. "The Queensland Naturalist" for April. An illustrated article on the Giant Stinging Tree (*Laportea moroides*) of the Queensland scrub or rain forest will be found of great interest.
2. "The Victorian Naturalist," June and July numbers. Two color plates illustrate an article on the Coral fungi (*Clavaria*), of Victoria and South Australia. An article in the July number on native cats treats of a subject which be of interest to our members.
3. "The S.A. Ornithologist" for July.
4. "The Western Australian Naturalists' Club Magazine" for June.
5. Linnean Society of New South Wales. Abstract of proceedings for May.
6. "The Australian Museum Magazine" June number. This number contains several articles of greatest interest, of which "The Way of the Wasp," Part I., is one of the most instructive.
7. "The Australian Museum Magazine," September number. "The Way of the Wasp" is continued and other well-illustrated articles afford interesting information on Australian nature topics.
8. Papers and Proceedings of the Royal Society of Tasmania, 1931. Dr. R. S. Rogers contributes a paper on the Orchidology of Tasmania.
9. "The Australian Naturalist," July number.

NOTE.—Held over for future issue:

Owing to the pressure on our space, articles by members have had to be held over.